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NOTIZIE DEGLI SCAVI DI ANTICHITÀ

SUPPLEMENTO AL VOL. XXX (1976)

HONOR FROST
e
AUTORI VARI

LILYBAEUM

NOTIZIE DEGLI SCAVI

Anno 1976 - Volume XXX - Supplemento

(SICILIA)

LILYBAEUM (Marsala). – *The Punic Ship: Final Excavation Report.*

PREFACE

The following pages represent the final field report on this underwater excavation, though by no means the final interpretation, if only because the structural findings and laboratory identifications that follow cannot be fully understood until more comparative material from both land and undersea has been discovered and published.

For this publication, we thank the Accademia dei Lincei *(which in the spirit of the European Community and true scholarship has presented the texts in the languages in which they were written) and the Editress, Dottoressa Paola Zancani Montuoro and her staff who have lavished much care and thought on this complex material.*

First among those who made the excavation possible is Prof. Vincenzo Tusa, Superintendent of Antiquities in Western Sicily. Realizing the interest of this ship, he promptly built freshwater tanks within the precincts of Palermo Museum, in which the wood could be washed and stored during the years that elapsed before its conservation treatment could begin.

In Marsala, Dott. Pietro Alagna has not only been our foremost patron throughout the excavation, but subsequently he became our most important collaborator who, throughout nine months of the year shouldered the responsibility of the wood treatment in the Laboratory erected on his own land (see Ch. IV). Words cannot express our indebtedness to him; without his constant help the entire undertaking would not have been possible. He it was who (from 1972) lodged the expedition in one of his properties and in conjunction with Signor Eduardo Lipari, provided the boats required for work at sea.

It was, however, Signor Lipari who was originally responsible for launching the project in 1969, when the presence of wrecks was first reported. During the prospection that followed, in 1970 and 1971, it was Eduardo Lipari who arranged for our accommodation: first on the Island of Motya (thanks to the hospitality of the late Miss Cordelia Whitaker) and the following year in a Caserma *(owned by the Finanza to whom we are equally grateful). Signor Lipari also provided us with a compressor for charging the aqualungs. We thank the owners of the Isola Lunga Development Co. who in 1974, having become our hosts on the Island, allowed us to moor our boats there. We are also personally grateful to their representative Avv. Emilio Caffarelli and his staff for much kindness and help including daily transport across the causeway to the Island.*

Support both in cash and in kind has come, over the years, from a great many sources. For financing the field work, we are principally indebted to the British Academy and the Society for Nautical Research of Great Britain. Their grants were, however, supplemented by the generosity of the following private individuals and bodies. The University of Aberdeen, E. B. B. Cunning, R. J. and E. Clark, G. F. and C. C. Howard, Arthur J. Imparato (U. S.), Louis Lehmann (Holland), The Lion's Club (Marsala), Manchester University Museum, The Monuments Trust (London), The Museum of Melbourne (Australia), Drs. N. J. T. M. and D. M. Needham, The Palestine Exploration Fund, The Hon. Mrs. Jocelyn Parker, the late Dott. Manfred Pedicini-Whitaker, Mrs. Rosemary Piele, Dr. A. H. M. Richards, F. B. Richards, The Society of Antiquaries of London, Chris Sullivan, Maurice Tempelsman (U. S.), Patrick D. Trevor-Roper, Raleigh Trevelyan, "Triton" (The Editor's Punic Ship Fund), Ben Whitaker, Sir James Whitaker Bart., Capt. Geoffrey Whitaker, Capt. James Woolfe-Murray.

Later, the costs of constructing the Laboratory, tanks and plant, also the purchase of polyethylene glycol etc. were met from two funds: the Servizio Turismo della Cassa per il Mezzogiorno *in Italy and the National Geographic Society of America.*

We also received support in kind; in Marsala itself help has always been readily given by citizens too numerous to name but to whom we are very grateful. For major items such as diving equipment, our warmest thanks are due, during the first two seasons, to Signor Michele Albanese of SCUBAPRO (Genova) for the loan of aqualungs and valves and the generous gift of masks, bags for carrying equipment, buoys etc. During the last two seasons, our thanks go to Inj. Giunio Santi and Admiral Fabio Gnetti of Sub Sea Oil Services (Fiumicino) for the loan of aqualungs (a change of patron occasioned by the greater ease of transporting heavy aqualungs from the South rather than from the North of Italy).

We are further indebted to Inj. Santi of SSOS for finding a source of PEG 1200 in Italy and to Shell Chemical for kindly donating the 300kg of it needed for experiment. Previously, Mr. Lappert of Shell Chemicals (London) had been instrumental in obtaining a similar amount of PEG 4000; we are deeply grateful to all concerned.

Another precious contribution to the excavation was an annual supply of "Netlon" in rolls and bag form. It was in constant use at sea for a variety of purposes, and later served both in the storage and conservation tanks. Our thanks are due to Mr. Paul Evill for drawing this material to my attention and to Mr. A. J. Wolstenholme of "Netlon" Ltd. for his generous gift.

Finally, we thank Boots the Chemists for a most appropriately furnished "red cross box".

Personnel

Much gratitude is due to all members of the expedition, most especially to those who, knowing that the conditions would be arduous, gave their services year after year. Foremost is Peter Ball, head engineer and diver throughout the entire excavation; as will be seen, he also designed and built many of the instruments used. During the two hardest seasons of submarine digging, he was ably assisted by Ray Strong. Another diver whose achievement is evident in the following pages is James Woolfe-Murray.

The recording of the wood was mainly the work of the architects Mary Anderson and Peter Brachi.

On land we were fortunate in the collaboration of William Culican (University of Melbourne, Australia) a specialist in Phoenicio-Punic pottery, and Dr. John Curtis (of the Department of Western Asiatic Antiquities of the British Museum). I am indeed doubly beholden to them for contributing to this Report: Chapter XI on Pottery.

I am particularly grateful to Miss Daphne Minton-Senhouse who, during the two seasons when the personnel was most numerous and the money shortest, ran the "dig house" with ingenuity, grace and kindness.

During the final year of excavation and subsequently the less romantic though equally arduous phase of conservation I am especially indebted to Mr. and Mrs. John Wood, whose help did not stop with the diving. Gail Wood has typed this manuscript, while John Wood's talents have been manifest in a variety of ways, not least in preparing and mounting delicate objects such as leaves and cordage for eventual display. Besides working in the Conservation Laboratory, both the Woods actively participated in the organization involved in our annual travels.

Though some names in this list reappear in the report that follows, space does not permit individual appreciation of the service which each freely gave on land and undersea, but each has earned my personal gratitude and an honourable place as a pioneer in the still very new discipline of wreck-excavation: Marie-Therese Barlow, James Barr, Christina Benn, The Hon. Miss Fiona Campbell, Deborah de Vere-White, Brian Dolley, Charles Edgerton, Antionetta Erlij, Paolo Giacalone, Christopher Gregson, Marcello and Angela Guarnacia, Ceri Hankey, Charles Harding, Howard and Lynn Hawkes, Robert and Sheila Henderson, Julian Ingelsby,

Nigel Kerr, Louis Lehmann, Francesco and Liliana Lombardo, representatives of the "Muscariello" Diving Club of Milan, Stephen Natanson, Ralph Pindar, Venetia Porter, Michael Potter, David Singmaster, Robert Sneath, Adriana Soja, Roger Tallentire, Sebastiano Tusa.

Though they were not present at the excavation of the Ship itself, my warmest thanks go to Gerhard Kapitän and Robert Knox who, during 1970 collaborated in the original survey of the wreck area, meeting the expenses out of their own pockets, as well as to Robert Yorke and David Davidson who further contributed supplies and transport that had been destined for an expedition of their own in North Africa.

Finally, I take this opportunity of thanking Nicola Laudicina (for assuring the processing of photographic records with a promptitude essential in underwater excavation), Stefano Pasalaqua (responsible for the two boats, who worked the clock round) and Diego La Mantia (for his care of the Conservation Laboratory). Though technically in our employ, the generosity of their help in fact exceeded the limits of any business contract.

In addition to the archaeologists, architects engineers, draftsmen and other personnel common to all underwater excavations, we were fortunate in our visiting experts.

Dr. William Johnstone (Arabic and Semitic Languages, University of Aberdeen) stands out in particular. He joined the expedition for four weeks in 1973 in order to scan each timber and himself record the paint marks and signs that it bore. His study which is as brilliant as it was painstaking, forms Chapter XII of this Report. Had no other result been produced, this study would by itself have justified the excavation.

Monsieur Georges Mascle (Départment de Géologie Structurelle, Universitée de Paris VI) who has longstanding experience of Sicilian geology, also visited the expedition in 1973 to see for himself how the ballast stones related to the wreck, before identifying such large quantities of thin-sections of samples that the pages of results given in Chapter IX must by archaeological standards, constitute a record. His contribution will doubtless increase in value as more comparable findings from other wrecks are discovered and published.

Dr. Edward Drew (Department of Marine Biology, St. Andrew's University) together with his own team, joined our expedition in 1971 in order to study the growth of Poseidonia *in the zone where the wrecks lay. His finding are published separately; they are not directly relevant to this Report, but they should prove of interest to future archaeologists working either in this area, or in one comparable to it.*

The classification as "visitors" may be disputed, but not my gratitude to the owner of the dredger "Motya", Signor Diego Martinigo, and its crew under Angelo Gherardi, who in 1973 helped us to combat the sand bank that had buried our site. The dredger's previous captain, Diego Boninni, had been responsible for discovering and reporting buried wrecks. Throughout the six years we spent at sea, whether engaged in prospection, survey or excavation, this dredger worked alongside us. Its crewman were friends and allies on whom we could rely for advice and to whom we are beholden for countless acts of succour.

After the excavation, when the conservation of the wood began, it was Prof. Michael L. Katsev (excavator of the 4th century B. C. ship at Kyrenia, Cyprus) who generously came to Sicily to give us the benefit of his experience, and guide the building of the first, experimental treatment-tanks in Palermo University. Subsequently, the conservator of the Kyrenia Ship, Miss Frances Talbot, also came to Palermo when tests were due on the first batch of treated wood. We are deeply indebted to both of them, also to Dr. George Bass (Director of the American Institute of Naval Archaeology, to which both Prof. Katzev and Miss Talbot belong) for authorising these journeys.

Our warmest thanks also go to Prof. F. G. Crescimano of the Istituto Coltivazioni Arboree *and to his staff for carrying out this first treatment of our wood, and to Palermo University for their hospitality in this respect.*

We are further very beholden to Prof. Giuseppe Donato and Dott. Dario Monna of the CNR in Rome, who initiated the arrangement and also made journeys to Sicily of this account.

For the conservation of small objects made of organic materials we thank the British Museum of Natural History, and Mr. R. H. Harris for his prompt action in freeze-drying them. We are also grateful to the conservator, Mr. Michael Kailas who then took over the delicate task of strengthening such objects by various treatments.

I take this opportunity of thanking each of the many laboratories (mentioned in the text that follows) for the identifications that they made. In this respect I am particularly grateful to Mr. Leo Biek (of the Ancient Monuments Laboratory, Department of the Environment) who despite his many commitments, not only spared time to act as guide and mentor whenever new and difficult problems of identification arose, but who also acted as interpreter, explaining to me the significance of the more recondite findings.

Mr. Austin Farrar, F.R.I.N.A. as architect, M. Paul Adam as expert on ancient ship construction and Mr. Frank Howard as model-maker, set out from these distinct points of departure to calculate, from the excavation records, the original shape of the ship. The debt we owe them can be measured by the fact that it is now possible to correct distortions suffered in the course of two millennia and reconstruct the original shape of the hull from the conserved timbers.

In writing this report, I am personally indebted to M. Lucien Basch for innumerable ideas and references—the fruit of our discussions on this ship and its background. So frequent were these exchanges that if any points attributable to him have crept into this text without due acknowledgement in the footnotes, I hope he will forgive the omission and accept this general expression of my thanks. I am, once again, grateful to John Curtis who has been kind enough to read this typescript.

Finally our thanks go to the excavation's distinguished sponsors; in England to the late Sir Mortimer Wheeler CH, Dr. R. D. Barnett CBE FBA and Dr. D. B. Harden CBE, whose support did not end with the permission to use their names, but whose help and advice was always readily available.

In Italy, the successive Directors of the British School at Rome: Mr. John Ward-Perkins and Dr. David Whitehouse, together with the School's Secretary (retired) Signorina Anna Fazzari, have taken endless trouble in support of this excavation.

Last, but by no means least, we owe an immence debt of gratitude to Senator Michele Cifarelli and his wife. Signora Cifarelli through her unflagging interest and support metaphorically re-launched this ancient ship.

After this report went to press the conservation of the ship's timbers was completed. In 1978 the remains of the hull were reconstructed in Marsala in a beautiful building, the " Baglio Anselmi ", appropriately situated on the tip of Capo Boeo the extremity of Europe nearest to Africa and Carthage.

Structural problems were inevitably clarified during the reassembling of the timbers and a second report could be written on this subject, but the text that follows remains an unrevised account of our field work and initial research. Specialists can now inspect this vessel and form their own opinion.

Honor Frost

London, 1980.

I. DISCOVERY

Wrecks in Surprising Surroundings

The Punic Ship is one of a group of wrecks in shallow water, close to the seaward shore of Isola Lunga (which lies between Marsala and Trapani). But when the ships sank the Island was not there; its formation is very recent. Even as late as 1828, the Punta Scario (the Island's western tip and the limit of the wreck-filled zone) does not appear on Smyth's chart. By 1898 (1) both this cape and the Island had taken on their present form, as shown on the Italian chart no. 266 (Ancoraggi di Trapani, Marsala) (2) (fig. 1).

Originally, the wrecks had sunk off a chain of islets running northward from Marsala to join the mainland coast at Punta Tramontana (or San Teodoro). The eventual amalgamation of these islets was due to the gradual extension of salt-pans which, by blocking the channels through the reef, diverted the through-currents causing them to deposit the sand they bore and so forming a new shore.

The memory of the islets is perpetuated in local names: one of the many applied to Isola Lunga itself being Isole dello Stagnone, which is not only a reminder of the plurality of the islets, but also of the fact that the lagoon that they bounded stagnated as it became land-locked (3).

In this Stagnone lies the Phoenician Island-town of Motya which was destroyed by the Greeks in 395B.C. Afterwards, this western tip of Sicily remained strategically essential to the Phoenician colonials who soon returned to it from Carthage, this time to found a new town outside the lagoon on the more easily defensible Cape of Lilybaeum.

The bearing which different kinds of terrain have on stratigraphic excavation is appreciated by all archaeologists. But those whose knowledge of underwater excavation is based on reading alone, will be unable to appreciate either the variety of submarine terrain or its implications. Indeed, they are likely to have acquired misconceptions. From most published photographs it would, for instance, be easy to deduce that a wreck is, essentially, a field of amphorae and that its excavation entails no more than the laying of a grid, so that the jars can be lifted from numbered squares. Further, non-divers naturally equate depth with difficulty. Nothing could be further from the truth. Wreck-formations are seldom a flat expanse of unburied finds. Depth, though it limits the time of a single dive, can increase the aggregate of diving hours, because fewer will be lost through rough weather that only affects the surface of the sea. Further, depth actually facilitates the digging of trenches in the seabed and the disposal of the resulting waste matter. Finally, no two wreck-formations are alike.

(1) The Cape is shown by A. Di Girolamo, *Sull'assedio di Lilibeo nella prima guerra punica*, published in 1898 in Trapani.

(2) W. H. Smyth, *Atlas of Sicily*, London 1824, contains an early version of his chart; see H. Frost, *Segreti dello Stagnone*, in *Sicilia Archeologica* 13, Trapani 1971, pp. 5–12.

(3) R. Molinier and J. Picard, *Notes biologiques à propos d'un voyage d'études sur les côtes de Sicile*, in *Annales de l'Institut Océanographique*, Monaco 1953, pp. 173–177.

Fig. 1. - In the foreground, the formation known as Punta d'Alga (composed of embanked *Poseidonia* leaves) running northwards from Marsala towards the Isola lunga (top left). The wrecks lie off the seaward shore of this island. Within the Stagnone, the largest of the islands is Motya; the mainland where it touches the Isola Lunga (top right) is known as San Teodoro (called after an ancient tower of the same name). *Air photo by courtesy of Dr. M. Aylwin Cotton.*

Consequently, if the reader is to evaluate an underwater excavation, he needs to be given a clear picture of the specific wreck formation, the engineering problems that it posed and the solutions that were applied to them.

The Role Played by Poseidonia

At Isola Lunga, the shore so recently formed has not yet reached stability. The size of the beach fluctuates as a result of winter storms, while undersea sand-banks over a metre high move constantly from one wreck to the next. This zone is bounded to seaward by *mattes* of *Poseidonia*, built up from the plant's rhyzomes which re-root themselves layer upon layer until, nearing the surface, their growth is arrested by the increasing temperature of the water. Mediterranean fishermen often call this kind of shoal " soft rock ".

The *mattes* flourish all round Marsala. They have completely filled the Stagnone so that only small craft can navigate its *intermattes* or channels. No such growth existed

during the siege of Motya, for the Greek and Phoenician fleets used the lagoon. Later, by the siege of Lilybaeum, the Romans had difficulty in finding the channels that led from the open sea into the town's harbour, and by the 19th century the *mattes* extended offshore for more than a sea mile. Even to the south of Modern Marsala, the larger ships carrying wine from the *baglios*, had to lie some 2 miles offshore in order to load (4).

The riotous growth of this plant impeded every mechanical aspect of our excavation. Conversely, it was responsible for the chemical conditions that accounted for the exceptional preservation of the wreck. When storms churned up the outer depths, they cast tons of *Poseidonia* leaves onto the shore. The violence of this local phenomenon is such that it is mentioned in the *Mediterranean Pilot* (under "Marsala") as the *Marrobbio*. Joseph Whitaker calls it the *Marobia* or ' drunken sea ' (from *mare ubriaco*) (5).

Its effects remain visible: the strangest being the Punta d'Alga, a rectilinear jetty-like formation running north from Marsala towards the Stagnone (see fig. 1). Along the coast-line, banks of dead leaves cover the beaches. At the Isola Lunga, they are also permanently awash along the shore, in a swirling brown mass which gives off a strong smell of rotten eggs, or hydrogen sulphide. The intrepid bather having climbed over piles of dried leaves, sinks waist deep into this dark spaghetti, wading through it for some 10 m. before he reaches clear water.

Like modern plastics, these leaves appear to be indestructable. Unlike plastics, we were able to observe within the wreck-formation, the many mutations they had undergone in the course of centuries. Even the modern weed will arrive on the site in many different forms: as a blanket of leaves about 30 cm. thick covering the wreck; as a carpet of balls (each made up of the rolled and compacted fibres of the plant); or as a fog of fibrous particles held in suspension in the water. Which form the almost daily plague will take depends entirely on the regime of wind and current that happens to be operative. The effects of the plague are various. A carpet of leaves masking the previous day's excavation can be cleared; it became a routine for me to " sweep " the wreck first thing in the morning, as I would sweep a house. The solid balls have to be gathered singly and disposed of down-current, at some distance from the site. No remedy exists for the fibres held in suspension; when these are present, photography is out of the question and only those who know the site blindfold can continue working. References to the long-term effects of these phenomena (*i. e.* the up to 2000 year old carpets of balls or blankets of leaves that had been trapped on the ship after it sank and were subsequently buried in sand) will occur throughout this report, because whenever we met one of these conditions we had to vary our technique of excavation, and frequently our instruments as well.

The Grouping of the Wrecks

Such is the setting; the wrecks were discovered by the crew of a dredger, who were taking sand for glass-making. As we have seen, sand accumulated in this area because of the artificial blocking of the through-channels which caused a south-flowing current to deposit the particles it bore. But even the powerful rotary head of this dredger (fig. 6 *b–d*) could not pierce strata of compacted *Poseidonia*, so dredging had to follow the mobile

(4) W. H. Smyth, *Sicily and its Islands*, London 1824, Appendix 26.
(5) J. Whitaker, *Motya*, Bell, London, 1921, p. 53.

sand-banks. Nevertheless, such was the number of the buried wrecks that notwithstanding this restriction the dredger bit into them.

The credit for recognising and reporting these sites belongs to Diego Boninni, the dredger's captain. He showed some of his chance finds to Signor Eduardo Lipari whose family had long been connected with local archaeology. It was to the latter's grandfather, the Cav. Giuseppe Lipari-Cascio—" my fellow worker ", that Joseph Whitaker dedicated his book: *Motya*. When in 1969, the diver-archaeologist Gerhard Kapitän and I were passing through Marsala to visit Motya, it was Eduardo Lipari with Diego Boninni who took us to see two of the wrecks off Isola Lunga.

Intrigued by a cargo of Roman Imperial tiles, Kapitän and I returned in 1970 to survey that wreck. But it was nowhere to be found; a roving sand bank had covered it. Not yet knowing of this local phenomenon, I was entirely mystified by the disappearance. The rest of the season was profitably spent surveying the other wrecks in the area.

The Sinking as an Act of War?

There is nothing unusual about wrecks being grouped, indeed groups are the rule rather than the exception, because ships tend to follow the same sea-lanes and sink on the same dangerous rocks. The wrecks at Isola Lunga are, however, surprising for several reasons. There is, for instance, no particular hazard to shipping off this flat coastline. Even if the offshore *Poseidonia mattes* had reached their present state 2000 years ago, they would neither have presented the same danger as rocks, nor would there have been a reason for ships to pass over them. Further, with the sole exception of the Tile Wreck (which proved atypical both in period and in kind) the wrecks that we surveyed did not appear to have been carrying a commercial cargo. When an amphora-carrier sinks, it will inevitably be marked by either a compacted mass of sherds or by unbroken jars (depending on the manner of the sinking and the character of the bottom). There were no such massed amphorae, or other form of solid cargo, at Isola Lunga; instead the sites were marked by ballast stones (showing that the ships must have been empty when they sank). A holocaust of empty merchantmen in one small area would be astounding; an alternative explanation was suggested by one of the wrecks we sounded in 1970. This was the site where a spearhead was found in the ballast-pile, and not far off, a warship type anchor. Its removable lead stock was missing, but the wooden stem (with the hole into which the stock had fitted) and part of the flukes had survived. Other objects which, like the spearhead had been made of iron, were also present. They were, however, formless with the exception of the " *corvus* ", so named because of its striking resemblance to this weapon (as illustrated by Folard) which had been used with particular effect during the First Punic War (see chapter on metals p. 136 and fig. 2 *a–b*) (6).

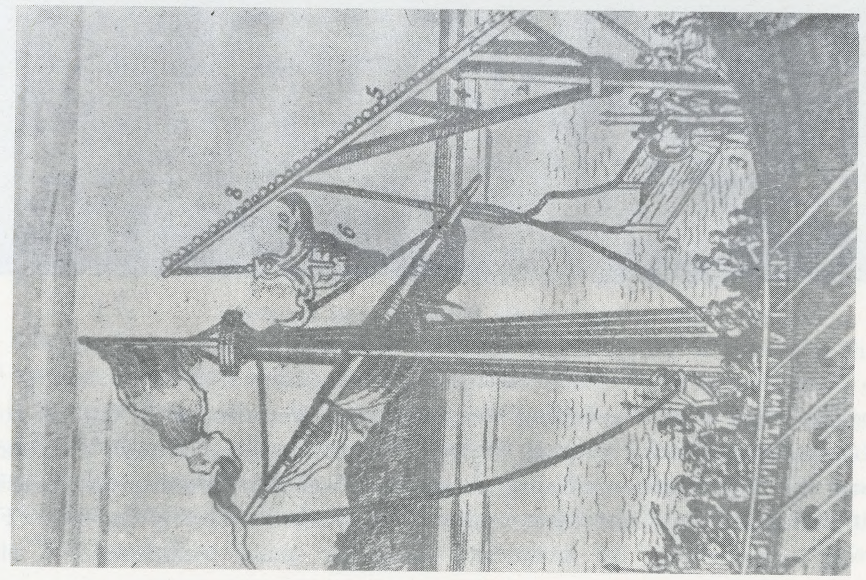
This association of finds suggested to me that the site might represent a warship; similarly, the other ballast piles in the area also implied sinkings that resulted from an act of

(6) For the Isola Lunga anchor and *corvus* see: H. Frost, *Relitto di una nave punica del III sec. a. C.*, in *NSc* XXVI, 1972, pp. 653–4 and fig. 5; G. Kapitän, *Rinvenimento di un'ancora antica del tipo a ceppo smontabile all'Isola Lunga*, (in press) in *Atti del IV Congresso Internazionale di Archeologia Sottomarina*, Nizza, 1970; H. Frost, *The Discovery of a Punic Ship*, in *IJNA* 1, London 1972, 113–117 and figs. 4 and 5.

For the 18th century illustration: M. de Folard, *Histoire de Polybe* 1, Paris 1753, Pl. 20.

For the *corvus* in use: Polybius 1, 22, 3–11.

b



a

Fig. 2. – *a*) The *corvus* hanging from the boarding-bridge (hoisted beside the mast) as illustrated by Folard in 1753; *b*) an iron object similar in shape to Folard's *corvus*, as found on the seabed on the " Anchor and Spearhead Wreck ".

war. Torr explains that ballast was needed in oared fighting ships to counterbalance their height: "*quantities of ballast would be required at the bottom of the hold; some gravel, or sand or stone was carried there for steadying the ship. And this ballast could be shifted fore or aft to depress or elevate the bows, as need arose for ramming or manoeuvering*" (7).

Discovery of the "Punic Ship"

No ancient warship had ever been found and it seemed improbable that this would ever occur in the sea. The reason is that warships kept their decks clear for fighting, so that when they sank and their waterlogged hulls opened out and became covered with sand, there were no solids to mark the presence of the buried remains on the surface of the sea-bed. Ballast stones by themselves are deceptive; even the piles off Isola Lunga at first appeared to me to be natural features of the bottom. Archaeologically, warships are of surpassing interest. Their architecture in particular has been much discussed, but only on the basis of the many and ambiguous references to it in classical texts.

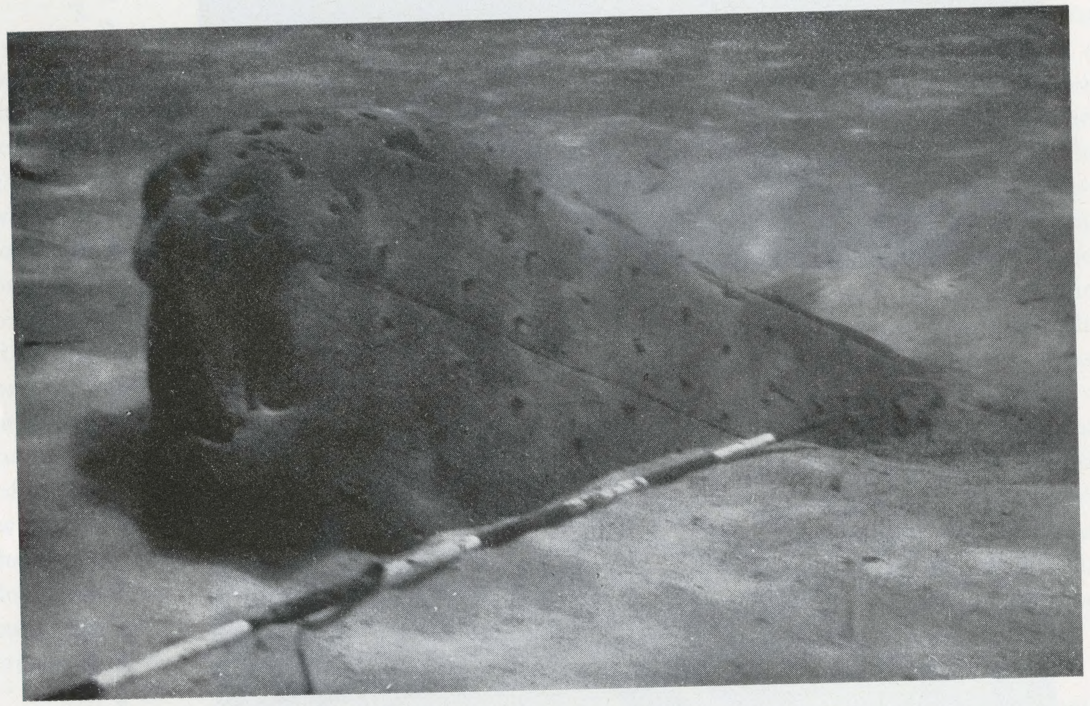


Fig. 3. - The sternpost of the Punic Ship on discovery.

Spurred on by the hope of at last finding a fighting ship, we returned in 1971 to sound the "Anchor and Spearhead Wreck". Again we were disappointed, for though we trenched through and around its ballast pile, we found no wood. Probably the ship had capsized, spilling its contents before the hull had been broken then washed away by the sea. Frustrated, we reverted to surveying by swim-line using the usual techniques. A single

(7) C. Torr, *Ancient Ships*, London 1894, p. 61.

swimmer holding 50 m. of tape would circle a fixed point (gradually unwinding his line with every revolution), or a team of swimmers spaced within eyeshot of each other, would advance abreast along a predetermined course.

Lack of discipline in this "swim-line technique" lead to the discovery of the "Punic Ship". David Singmaster (expedition photographer in 1971) signalled a find. Considering him to be off-course and too near to the shore to have come upon anything significant I reluctantly answered his call. The mysteries of the sea are, however, inexhaustable; between two piles of ballast-stones, a large timber (such as I had never seen before) emerged from the sand like the head of a primaeval animal crowned with weed; the presence of a buried wreck was evident (signs painted onto its hull, later proved the ship to have been Punic) (fig. 3).

The top of this first timber must have been exposed from time to time in the course of centuries, according to the ebb and flow of the zone's peripatetic sand-banks, but the rest of the wreck-formation once it had reached stability had remained protected by sand-burial. A hand-sounding of no more than 30 cm. down from the head of the timber revealed fresh looking reddish wood studded with bronze tacks, covered in places by the bluish remains of the lead that had once sheathed the hull. The depth of water was only 2.50 m. and the wreck's somewhat variable distance from the unstable coastline was in the order of 50 m. Consequently the site was always well within the influence of the breaking waves. The coast being exposed, days of flat calm were exceedingly rare.

The Sister Ship

Only 70 m. to the south of this first wreck, we were to discover a second almost identical formation. Its contents being Punic as well we christened it "the Sister Ship". At the beginning of the final season of excavation, in 1974, the sand-bank covering the Sister Ship retreated, baring a significant amount of its timbers. John Wood had time to survey them while he was waiting for the pumps to be mounted over the Punic Ship

It was not, however, until the completion of the Punic Ship's excavation and the dispersal of the expedition that I could return to examine an anomaly John Wood had noticed. It turned out to be the prow, complete with the framework of its ram (8) (see p. 265 ff).

This unique find provided exactly the information that was lacking on the Punic Ship; I will therefore refer to it in these pages, whenever it becomes relevant to the main excavation.

The Punic Ship; Its Importance

On the Punic Ship, excavation revealed a good part of the keel; the port side of the hull up to the waterline and most important: the stern. The preservation of a ship's extremity is so rare that before the discovery of the Sister Ship's prow, this stern was virtually unique. Underwater, the vulnerable upright parts of a hull usually break off and are destroyed as the wood becomes waterlogged and the sides flatten out under the weight of the contents before reaching stability (after sand-burial has integrated the wreck with the

(8) L. Basch, *Another Punic Wreck in Sicily; its Ram. 1. A Typological Sketch*; H. Frost, 2. *The Ram from Marsala*, in *IJNA*, London, 1975, 4, 2, pp. 201-228

sea-bed). Architecturally, the significance of a ship's extremities is crucial, because without at least one of them, it is impossible to deduce the original shape of the vessel with any degree of accuracy.

Other exceptional features soon became apparent on the Punic wreck. Prof. Vincenzo Tusa, the Superintendent of Antiquities, Sicily, was quick to recognise them, and took steps to make fresh-water tanks available in the National Museum, Palermo, so that the raising of the wood could proceed. First in importance were the Phoenicio-Punic alphabetic signs painted on to the hull. Second was the astonishingly good preservation, especially of organic matter such as cordage and dunnage. From the freshness of some of the trapped plant material in this dunnage, it was possible to deduce that the ship had been new when she sank. This is significant because it follows that it may also be possible to deduce the geographical location where this particular ship had been built.

Hitherto, the absence of such evidence on other wrecks has constituted a serious limitation in naval archaeology. This is because if the number of voyages a ship made before being wrecked is unknown, then there is no way of telling which of the artifacts found on her wreck represent her home port and which represent ports of call. It follows that when a particular build of hull emerges as the result of excavation, it will be impossible to attribute it to any particular region in the Mediterranean. Consequently naval archaeologists will not be able to discuss comparative design and construction with any degree of certainty.

The Marsala wreck is therefore important because it not only bears irrefutable evidence of its origin in the form of Phoenicio-Punic lettering, but also potential evidence for the location of the shipyard where it was constructed. Conclusions must, however, depend on the interpretation of a mass of detail. The fact that the findings are so detailed, is entirely due to the techniques and tools designed to meet the peculiar requirements of this excavation which, since it was carried out underwater, need to be stated.

Honor Frost

II. EXCAVATION

The Tools for the Job: Determining the Method

It is easy to recover objects lying on or under the seabed—even those encapsulated in marine concretions, but to do this in such a way that no crumbling fibre or paint mark will go unrecorded, involves skill and practice. Powerful dredging equipment is essential, but inability to regulate it to meet specific requirements, or clumsiness in using it, means that delicate artifacts will be sucked up and dispersed, as a cloud of dust, into the surrounding sea.

Because of the shallowness of the sea over the Punic wreck, powerful and therefore relatively heavy equipment was always in some danger: unless the anchoring was impeccable, boats, pipes and dredges risked either hitting the recently exposed antiquities, or being tossed onto the shore by the waves. I have so often been asked why, in these circumstances, I did not

a) build a coffer-dam, or

b) base our pumps on land

that both contentions must be general enough to warrant a brief explanation.

Had a coffer-dam been technically desirable, then our choice must have been between either finding the money to build it (though this would have run into a million dollars), or abandoning the project, leaving the wreck in the relative safety of its sand-burial. The choice did not have to be made, because a coffer-dam was utterly undesirable. This would be evident to anyone who knew the exposed and unstable shore. Further, anyone familiar with groups of wrecks, will understand the danger of imposing limits on one site, *before* excavation has shown the extent of its burial. There were in fact, two other sites in addition to the Sister Ship, almost touching the Punic Wreck, which the walls of a dam would have damaged.

Finally these objections are minor by comparison with the dangers of exposing waterlogged antiquities to the sun and air and the impossibility of safe handling after they have become subject to the full force of gravity. A waterlogged plank 3 m. long has the consistency of hard-frozen butter. A small piece would be easy to handle, but to move a long piece without damage entails picking it up, splinting it, than tying it with some soft kind of rubber bandage. In the air, the plank would probably break as it was being drawn out of the surrounding mud, but underwater, where the force of gravity is minimised, the same operation could be carried out without either difficulty, or damage.

Similary, delicate artifacts such as rope, that had been reduced to the consistency of tooth-paste, can be boxed underwater then brought to the surface undisturbed, whereas if the surrounding water were to be drained off, their substance would drain away with it. If waterlogged material is to be conserved, it must be transferred quickly and gently, without the air reaching it, to freshwater storage tanks (where it will remain, until washed free of salt so that treatment can start). In Northern Europe, some boats have been excavated

on land in bog-like conditions, or even in coffer-dams, but both the woods and their chemical environments are so different that they in no way compare with the type of Mediterranean wreck we are discussing.

As for basing our dredging equipment on the Island: even if road transport had been available, the shore made up of weed mounds would have been both unsuitable and unsafe. Further, the power of the dredger would have been seriously reduced by the extension of its tubing over a distance of at least 50 m., while the anchoring of these pipes, so that they could not break loose and flail across the wreck, was a problem which I had no wish even to contemplate.

The Boats

By comparison, the mounting of suitable pumps onto the small boats that were available to us (see acknowledgments) appears like child's play. It was, however, not so easy. The axiom that ' no two wrecks are alike ' cannot be repeated too often. The waves that broke over this ancient hull and its fragile contents, were without precedent. Naturally we made mistakes and accidents did occur, but happily, no damage was ever done to the antiquities.

The local craft that we used during the major part of this excavation consisted of:

The Kepi III a 14 m. boat designed with a shallow draft in order to carry salt from the Stagnone. Known as a *schiffo*, it drew just over a metre of water, but even this was sufficient to prevent us from mooring it over the wreck. The converted hold provided cooking arrangements and some comfort for the divers, while its roof and the surrounding deck gave sufficient space for the instruments and aqualungs and, more important, for carrying the larger timbers lifted from the wreck.

The Motya an 8 m. fishing boat, had a sufficiently shallow draft to be anchored over the wreck, but it had no deck and the central space was almost entirely taken up by an archaic engine and the largest of our dredges.

A 2 m. inflatable rubber dinghy was sometimes used as a raft to carry the lighter dredge.

Mooring

A three point mooring system was arranged so as to keep one of the dredges precisely where we wanted it on the wreck. Without it, because of the unpredictability of the winds which habitually veered 180° and frequently turned the entire circle, anchoring would have had to have been repeated in the course of a single day.

Similarly, whenever the discharge of sand and weed from the dredge was carried back onto the divers, the mooring of the discharge pipes either had to be changed (a tiring job that took over an hour), or the work in hand had to be abandoned in favour of some other task on a part of the wreck unaffected by the fallout. Never was it possible, *as it would have been in deeper water*, to plan a working day in the knowledge that the programme would not have to be modified.

The larger *Kepi* always lay off the wreck, at a distance of 20 or 30 m. (depending on the wind). When only one or two divers were needed on the site, we often preferred the discomfort of the smaller, *Motya*, to the exhaustion of loading both boats and the expense of taking them from their nightly anchorage to the site.

Digging Tools

Air-lifts and dredges should always be designed to meet specific factors such as the depth of a wreck, the depth of its burial and the quality of the mud, sand, stones or weed-growth etc., that cover it. Where only one or two of a cargo of amphorae show on the surface of the sea-bed, a hull may be buried a couple of metres beneath them, so a very powerful instrument will be needed to liberate the entire site by trenching round it, whereas a hull covered by a few centimetres of sand needs only the equivalent of a feather duster. The Punic wreck being more atypical than most combined these extremes; its burial was shallow until the day when a peripatetic sand-bank turned it into a deeply buried site. The change which occurred half way through the excavation, was as dramatic as it was unforseable; from using expressly designed instruments small enough to be manhandled onto a rubber dinghy, we suddenly had to resort to using the huge, commercial sand-dredger.

The mini Air-Lift

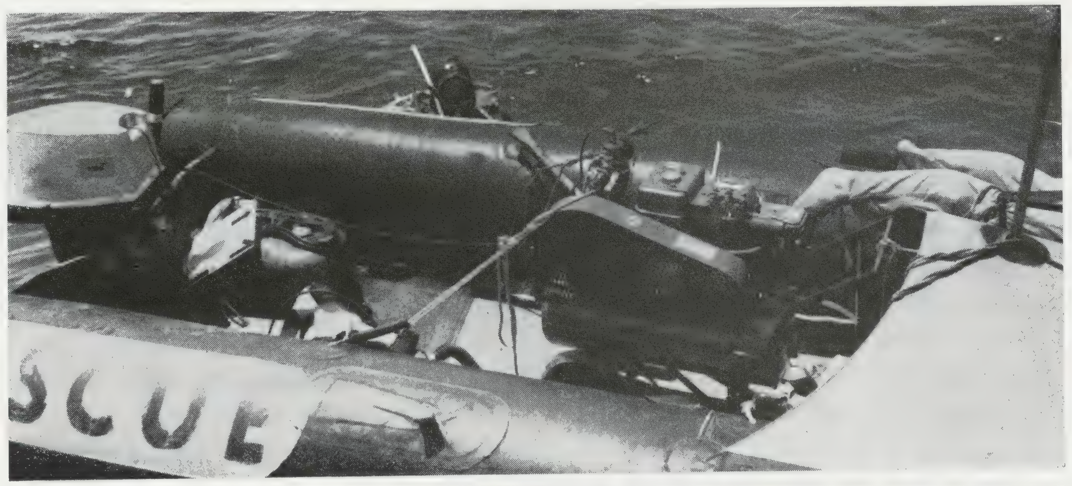
In 1971, it will be remembered, the expedition set out to sound the Anchor and Spear-head wreck which lay a couple of hundred metres offshore in a depth of over 6 m. It was logical to assume that any hull that remained would have been pinned down by the ballast stones, so that once these had been removed by hand, only shallow sand would cover the wood. The engineers were briefed accordingly; Robert Sneath, helped by Peter Ball (both engineering students at the Polytechnic of the South Bank, London) produced a small air-lift. It proved entirely satisfactory, and had the advantage of being so compact that it could be manhandled onto and used from a rubber dinghy (figs. 4; 4 *a*).

Air-lifts work on the principle that air introduced underwater, into the bottom of a near vertical pipe, will expand as it travels towards the surface (in proportion to the decreasing pressure of the surrounding water). The force thus generated carries sand or mud upwards. Consequently, the deeper the water the greater the expansion of the air and the power of the air-lift.

Though even 6 m. is shallow, Robert Sneath's air-lift fulfilled its function, but when it had to be transferred to the Punic wreck, at less than half the depth, I could not believe that it would work at all. It did, however, perform remarkably well because of its careful design (having only a three inch diameter bore and an efficient infusion head). The fact that it was not very powerful was no disadvantage during the first year while we were feeling our way. We had, for instance, no idea that the Punic Wreck would contain such quantities of delicate organic matter. But by the end of the season, when the massive stern timber had to be dug out of sand at least a metre deep, the air-lift's lack of power meant long and tiring sessions for its supervisors. Its other disadvantage on the shallower site was that, because the discharge pipe had to be kept at near vertical, a good part of the discharge fell back onto the excavators. In deeper water this would have been minimised, because there would probably have been a current between the surface and the bottom end the pipe itself could have been angled sufficiently to carry the discharge further away.

The small Mud-Dredge

The following year, knowing the buried hull and that there was a lot more of it to be excavated, Peter Ball (who remained head engineer throughout the excavation) designed and constructed a more suitable instrument. This was a mud-dredge that worked on the



a

b

Fig. 4. – *a*) Air-lift motor in the rubber dinghy;
b) Air-lift working underwater

venturi principle (which is more appropriate for shallow water). The dredge was built from readily available materials. Because the covering of sand was shallow, little emphasis was laid on designing for maximum power, instead low cost and simplicity were the criteria. The result was simple, effective and robust. The nozzle was made from steel pipe fittings. The discharge was carried away from the excavation first, through 3 m. of flexible PVC pipe which fitted over the nozzle allowing it to be moved over the site without disturbing a further 6 m. of heavy duty PVC pipe which finally discharged the sand at a safe distance down current.

Like Sneath's air-lift, Ball's mud-dredge was sufficiently low-powered and compact for its power-source to be manhandled into the rubber dinghy anchored over the wreck. The dredge was powered by a pump capable of delivering 125 gals/min, driven by a 3 hp four stroke engine. The water was carried to the nozzle through a two-inch diameter unreinforced PVC lay-flat hose. This hose proved unsatisfactory, tending to split under the heat of the sun combined with the dredge's pressure. The following year it was replaced by a hose of woven fabric capable of withstanding the dredge's full pressure (fig. 5 *a*).

The Excavation Jet

Whereas a dredge sucks, it is often useful in an excavation to be able to reverse the process and blow. Indeed, blowing being speedier than dredging, this would be an ideal way to clear a wreck lying on a slope where the sand could be blown "downhill". Even on a flat site such as the Punic Wreck, blowing has its uses, for instance to create an artificial current which will carry away the cloud of mud rising from excavation so that photographs can be taken, or to dust off the film of sand that settles over a newly excavated expanse of hull.

a b

Fig. 5. – *a*) Ray Strong using the small mud-dredge (photographed after advent of the sand-bank which caused this dredge to break down as the result of over-use); *b*) the water jet used by its designer Peter Ball.

Ball produced such a "blower", ingeniously combining it with the dredge. Having reduced the diameter of the hose at the pump's jet to three quarters of an inch, he compensated for the loss of power that this caused by introducing a long reducing section which, when not connected to the dredge, could be used for blowing. Such jets are, however, difficult to handle, so their usefulness is increased by fitting a control valve into the nozzle, making it possible to adjust the flow-rate to a trickle (fig. 5 *b*).

Filtering the Discharge

The extremity of the dredge's discharge pipe was always fitted with a plastic mesh "Netlon" sack which retained all solids less than 6 mm. across. We piously collected these sacks as soon as they were full, picking through their contents in case some shred of evidence might have been sucked up.

The task was unpleasant, boring and unrewarding. The unpleasantness was due to the prevalence of bluish-black decayed lead; even underwater it would stain the excavator's hands and feet. The non-divers who sorted the sacks on the surface, looked like ancient Britons covered with woad. The fruitlessness of their searching was a compliment to Peter Ball and his small band of pump-tenders, who were so skilled that hardly anything ever got into the bags. The only finds, over the years, were fragments of corroded nails and the odd young octopus which, during the night had claimed "squatting rights" in the pipes which had been left on the bottom.

The Advent of the Sand Bank

By the third year of excavation, I fully realized the instability of the zone and the potential movement of the sand within it. Nevertheless, like cancer, the sand-bank came on to our own site as a surprise. Seventy metres to the south, the timbers of the Sister Ship had been laid bare for the first time by the shifting sands, while a kilometre further the Tile Wreck, buried since 1970, showed more clearly than before.

The Punic Ship had disappeared.

Of the two concrete blocks marking its base-line, each of them surmounted by an iron bar 70 cm. high, only the extreme tip of the seaward bar showed. The ballast piles were almost entirely covered. The beach had advanced some 20 metres, and it was possible to stand with one's head out of water on the landward end of the wreck. In addition, the weather was stormy and remained so throughout the entire season.

I arrived at Marsala a couple of weeks before the rest of the team (who were by then preparing to leave from their various bases: John Curtis from as far away as Persia). There seemed only one thing to do, though that was a gamble: to hire the commercial sand dredger and with it to make either peripheral holes, or trenches that might drain the sand off the wreck itself. In this way, when Peter Ball and his assistant Ray Strong (another engineer from the Polytechnic of the South Bank) arrived, I hoped that they might be able to carry on with our own small dredge. Hiring the large commercial dredger was naturally very costly. That it was possible at all was due to the generous grant we had just received from the National Geographic Society of America.

After 13 days struggle with this dredger (which was also called the "Motya"), the site was only marginally better than it had been to begin with. I must, however, put these events on record for the sake of others who may find themselves off a similar shore, and as a tribute to the skill and tenacity of the dredger's crew under Signor Angelo Gherardi (Diego Boninni having left) (fig. 6 *a–d*).

The Dredger

The dredger was capable of digging three metres into the bottom in a matter of minutes. Consequently the volume of its discharge was very great; for various technical reasons the sand from the Punic Wreck could not be put into the dredger's hold, so the first job was to ensure that the discharge would be carried a considerable distance from the wreck area. To this end. 50 m. of heavy piping were deployed on the surface, buoyed up by two 50 gal. oil drums every 6 m. and firmly anchored by large *tonnara* grapnels. This took two days to accomplish, but no sooner was the piping ready for use, than an overnight storm cast it onto the shore as though it had been a loose string of fishing floats. The manoeuvre was repeated, and again destroyed. We then took to laying a shorter discharge pipe each morning, or rather on those mornings when, before first light, it was considered worth going to sea at all. Sometimes we even set out, only to be turned back by the weather.

On days when work was possible, my own task of directing where the holes should be dug was not easy either. All but one of the fixed points on the wreck had been obliterated; I had not only to estimate where our excavation had been, but also its hitherto unexcavated limits. Twice we touched the outsides of the ballast piles; the stones made a fearful clatter as they were carried up the dredge. At all times I watched its rotary head in terror as it bored deep into the compacted sand, expecting to see waterlogged wood churn-

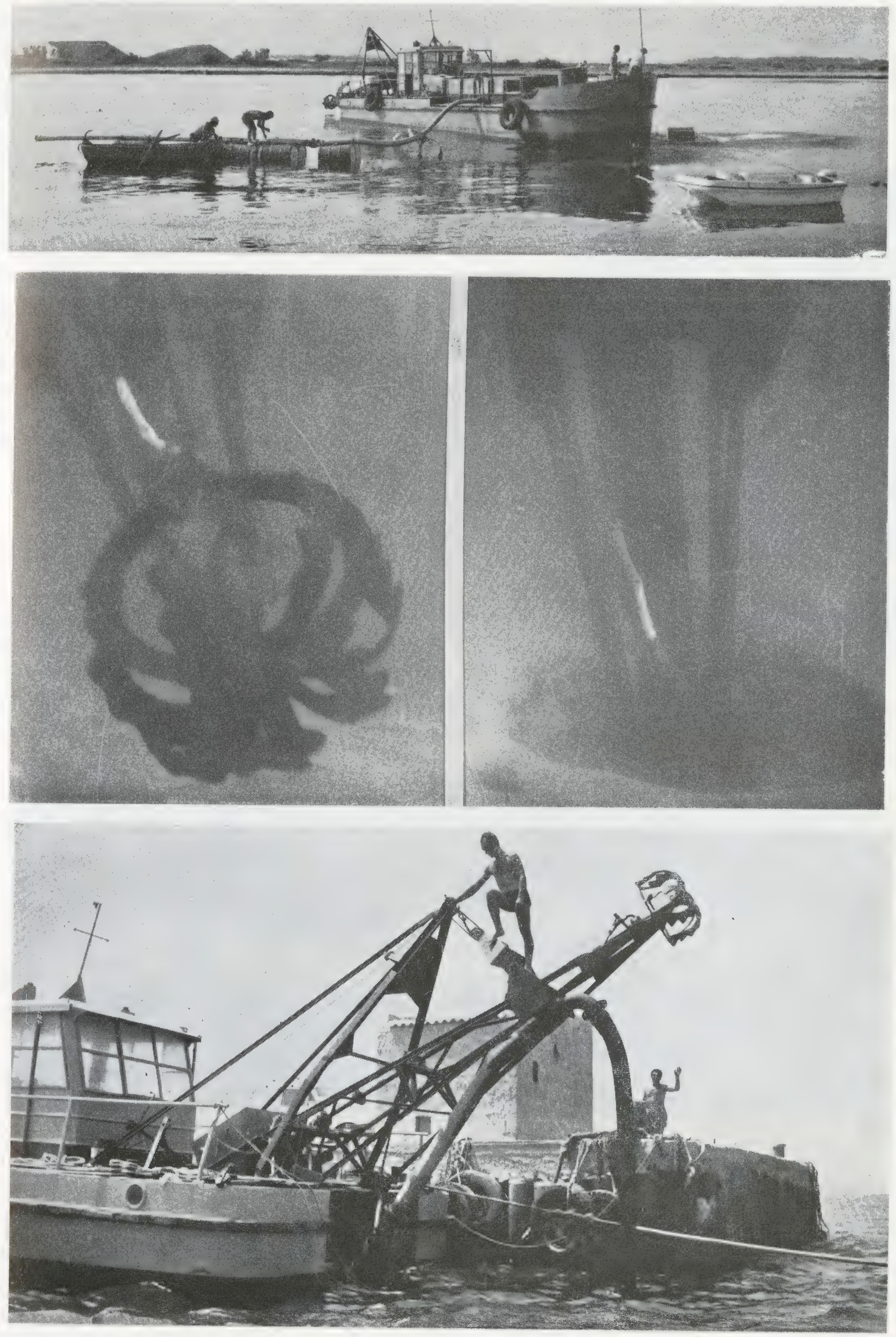


Fig. 6. – *a*) The sand-dredger "Motya" which discovered the wrecks in 1971, being used in 1973 to free the Punic Ship from a sandbank that had covered it during the previous winter. In the foreground discharge pipes are being laid; *b-c*) The powerful drilling head (seen underwater) dug quickly and deeply into the seabed, but could only be controlled from the surface; *d*) To transfer control to the diver an intake pipe was added and the drill head left unused.

ing round in the hole. On the surface, Angelo Gherardi's eyes never left the spot where I was, in case my hand emerged from the water signalling him to stop boring (grossly overweighted because of the shallow depth and unable to wear flippers because of the work I was doing I could not get my head out of the water, indeed it was difficult to surface at all). If the holes were too far from the site they would be useless, if they got too near they might be disastrous. The procedure was nerve-wracking; we changed tactics substituting an intake pipe for the rotary head (see fig. 6 *d*).

This transferred control underwater, to me (though the pipe was so heavy I could hardly move it). The extraordinary dredger, despite its size, drew less water than the "Kepi". It could work in only one metre. Thus, with the new pipe and thanks to Gherardi's steering on the surface, I was able to make a shallow trench parallel with the land, across the site where the sand was deepest. The weather had remained so bad that out of 13 days only three were spent in full-time dredging. By the time Peter Ball arrived with our own small pump, the results obtained by the dredger had been more effective psychologically than materially. Only one large hole remained, the others and the trench had refilled almost immediately, but at least the sand had been loosened and I had a clearer idea of where the ballast stones lay.

Our Small Dredge is succeeded by the "Bestia"

The wreck had become my "Moby Dick", and I think Peter and Ray must have felt much the same. Knowing only the position of the seaward end of the base-line, we started to dig with our own small dredge in search of another marker: the port piton. Once in possession of a second fixed point, it would be possible by reference to the 1972 plan and trilateration, to work out exactly our position above the buried wood. Having at last

a *b*

Fig. 7. – *a–b*) Installing the dredge "*bestia*" into our smaller boat.

unearthed this second piton and calculated the position of the third, we decided to trench across the after portion of the hull to this starboard piton. The ribs of the ship having been raised in 1972, the intention was to raise the planking in 1973, starting at the stern.

Ray took the pump; I have never seen such dogged determination; he stood guiding its heavy head hour after hour and day after day. The double tanks of compressed air that we were using lasted 2½ hours at this depth; we each averaged 5 hours per day under-

water. He first disengaged part of the port ballast pile, so that we could all go on working there by hand.

He then finished the shallow transverse trench, reaching the starboard piton, before the pump broke under the strain. Completely worn out, its motor started emulsifying a mixture of oil and water, making it into a disgusting kind of mayonnaise.

A more highly powered dredge had to be found quickly and locally. The story of how this was done might move a reader to either hilarity or tears, but it would have no place in an archaeological report. Neither is it relevant to describe in detail the makeshift dredge that was obtained. Had the excavator's engineers designed a more powerful dredge to meet the new requirements of the site it would have been very different. To say that the "*bestia*" as we called it, was temperamental, clumsy and unsuitable, does not detract from our gratitude to the Whitaker Estate for lending it to us. They could neither have been kinder, nor could a better alternative to the dredge have been found in Western Sicily. Similarly, no criticism is levelled at its builder Signor Vincenzo Amato, who went to a great deal of trouble installing the dredge on the fishing boat "Motya". The fact was that he had designed the "*bestia*" as a land-based dredge to empty mud from the *Cothon* (an ancient tank or dock on the Island of Motya) where Professor Isserlin had last used it during his excavation in 1972. Thereafter, it had stood idle for a year in the open air. Nevertheless, the *Bestia* exactly met our needs; it had a 14 HP motor and the capacity of its pump was m. 3–100 per hour (1). Thanks to Dott. Pietro Alagna it was less hastily and more efficiently refurbished for the final season on the wreck. I doubt whether it will ever see service again (fig. 7 *a–b*; *c*).

Fig. 7 *c*. – Peter Ball controls the "*bestia's*" heavy head; had he dropped it, it would have bored through sherds and waterlogged wood before the motor on the surface could have been stopped.

Sandbagging Unraised Wood between Seasons

From the moment that the protective covering of sand mud or cargo is removed from ancient organic matter, decay sets in. When first uncovered, timber will still retain its original colouring. The Punic Ship having sunk when new, its pinewood planking was a fresh yellow, the oak brown and the maple a reddish colour, but as soon as the oxygen in the water reached the wood, it started to darken.

Once the stability of any wreck-formation is destroyed, other processes of decay also begin; on a shallow site in turbulent water there is the additional danger of fragile material being broken up and dashed onto the beach by storms.

All hull excavation should, in my opinion, proceed metre by metre so that a minimum of wood is exposed and only for a short time, before it is lifted. The argument against

(1) *Motore HP 14; portata pompa m. 3–100 per ora.*

this method is that it is not conducive to spectacular photography—an argument that did not apply on this wreck where both the shallowness and the turbulence of the water in any case impeded the taking of long shots. Regrettably, some hulls have to be left on the bottom after they have been recorded in which case the wood is automatically put at risk. Certainly on all continuing excavations some degree of danger will arise at the end of each season when parts of the wood still show and the stability of the wreck will have been modified by digging. In 1971 after the Punic Ship's stern had been raised, the adjacent planks were visible, as was some of the organic material that filled the still buried portion of the keel-cavity. Similarly, in 1972, after the ribs had been removed from a large part of the port side of the hull, the planking beneath them needed to be protected during the ensuing winter.

The way we did this was to cover the wood with a thin layer of sand, then to weight this down with sand-bags which, in turn were covered with more sand (by reversing the dredge or air-lift so that its discharge fell back on to the wreck). Sand alone is insufficient protection because once the stability of the bottom has been upset, there is no guarantee that the recently loosened sand will not shift again. Even if it did not, the same slow process of excavation would have to be repeated on the following year, whereas if a layer of sand-bags have been laid, the full force of a dredge can safely and speedily be used on top of them, before the bags themselves are lifted by hand to expose the particular portion of the hull where excavation is to resume.

In addition, the presence of these bags on the bottom is a great convenience during excavations. They can be used to weight down the sheets of polythene while planking is being traced (see p. 33); or to cushion the feet of such metal instruments as grids and templates so that they do not damage the soft hull; or to build barrier walls to prevent sand from flowing back onto newly excavated trenches. The bags can be made from lengths of lightweight plastic tubing cut from 50 m. rolls. Lengths of about 1.50 m. are knotted at one end, filled with sand scooped up from the seabed near the wreck, then closed with a second knot.

Lifting the Ballast Stones

This operation had to be manual, but underwater because of the diminished force of gravity, the task is not too difficult. The type of basket common throughout the Mediterranean (some 70 cm. high and 50 cm. across) is filled with stones: a stout rod such as a length of tubular metal is passed through its handles, so that the diver can pick the basket up and walk the load to some convenient position beyond the site and empty the stones. To reduce the weight of the load, I would partially fill tubular lifting-bags with air from my breathing tube, then loop their ends round the extremities of the rods. Such bags which can be tied like sashes round a diver's waist, were patented by the well known diving teacher M. Georges Barnier of Cannes. Originally designed as a kind of swim-wing, their uses in underwater work proved to be innumerable, their greatest advantage in diving being their simplicity and portability; no other form of float can so easily be carried, inflated, or emptied on the bottom.

Honor Frost

III. RECORDING

Recording underwater

Ballast stones had shown that when the Punic Ship sank, there could have been no cargo inside it. The fact that its hull was virtually empty, simplified the general plan-making. Site plans were of secondary importance by comparison with the detailed recording of the ship's wooden structure. As usual the basic principles of surveying had to be adapted to meet the individual characteristics of the site.

On cargo-filled wrecks, the mapping of layers of amphorae is time consuming, yet conscientious archaeologists have to establish the position of each jar because it is essential to know how a ship had been loaded. Usually hull recording can only start after the pottery has not only been plotted, but also numbered and raised. It took 13 years for a team of experienced divers working in all seasons to ' unload ' the cargo of the Grand Congloué wreck; this was before the introduction of modern recording techniques, but nevertheless the site was never completely cleared! For the past 3 years, excavation has been proceeding on another large amphora-carrier in France, this time in accordance with the best scientific principles, but again, the work is likely to continue for 10 more years.

Only because the Punic Ship was cargoless was it possible to achieve a full and detailed excavation in 4 seasons. For the same reason, its surveying did not follow the lines that are becoming accepted in the planning of merchantmen; no elaborate reticulations of grid-squares, or semi-permanent tubular metal scaffolding was erected over the site. They would have been impractical in such shallow water, and were in any case unnecessary, because the hull itself served as the best possible " grid " in which to situate the few artifacts it contained. It was for instance, more accurate as well as easier to show an artifact as being " between ribs 12 and 13, on plank number 11 ", rather than to stretch tapes over the seabed with the sole purpose of situating the object in a square with an arbitrary number attached to it. But of course the hull itself had to be recorded before the objects could be related to it. This was done in two ways; I will start by describing the most important if least conventional.

Hulls being curvilinear structures, it is inappropriate to record them planeographically, as though they were houses (which can readily be understood from their ground-plans). We did of course make conventional plans, such as fig. 9, but though useful as an illustration to this text, the figure is a perspective view, so it is not much use to a naval architect. In theory, the eye is vertically above everything that has been drawn; thus when the hull takes a steep curve downwards towards the keel, its foreshortened strakes are represented as parallel lines which grow closer to each other as they near the keel. Give this plan to a model maker, and in order to find out the width of an individual strake, he will have to waste his time making a series of calculations reversing the laws of perspective. Again, unless layers of artifacts have to be plotted, plans are not a convention that should be used as the sole, or even the principle method of recording a ship.

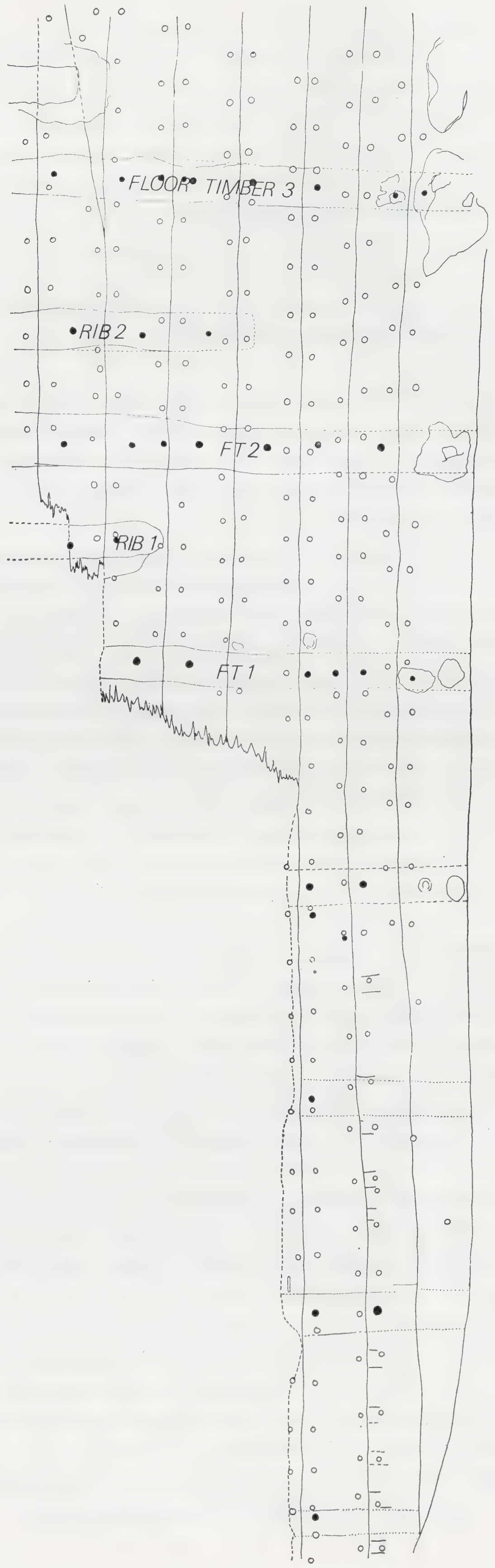


Fig. 8. - Example of a tracing made underwater onto a large sheet of polythene laid over the planking of the hull. This tracing is here reduced to a scale of 1 : 10.

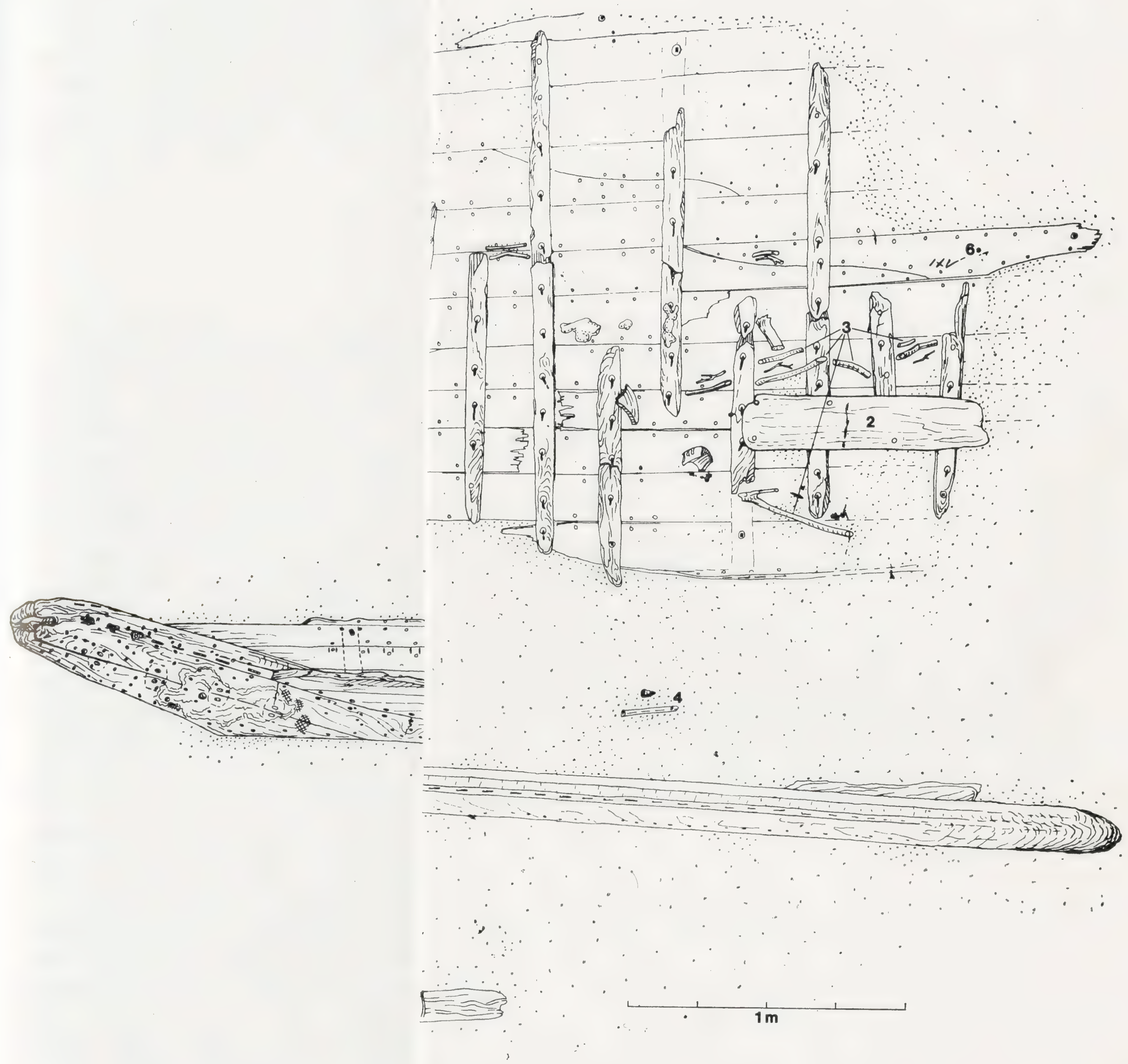


Fig. 9. - Plan of the Punic Wreck at Ma cat-walk parallel to the keel and over the ribs; 3) Branches used as dunnage; they are cut with a knife at e the keel (see fig. 110); (6 Alphabetic signs and other shipwright's marks; ooth ends are cut, one is faceted.

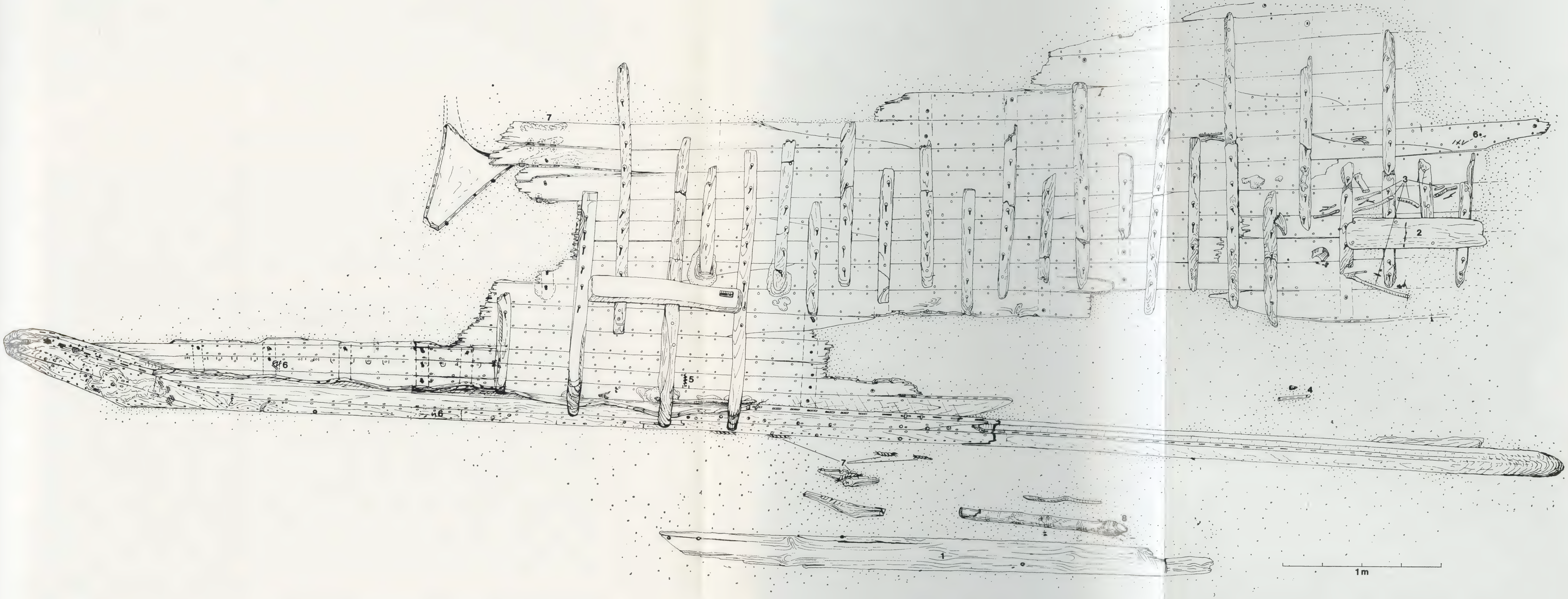


Fig. 9. – Plan of the Punic Wreck at Marsala (second season of excavation). 1) A plank without mortising along its edges, i.e. not from the shell of the hull; 2) An oak plank, probably one of a series forming a cat-walk parallel to the keel and over the ribs; 3) Branches used as dunnage; they are cut with a knife at either end and fit between the ribs; 4) A bone needle and a false killer whale tooth (see fig. 9); 5) Squiggly line directly above the scarf that unites two timbers forming the keel (see fig. 110); (6 Alphabetic signs and other shipwright's marks; 7) Fragments of rope, possibly from the same length that re-emerges beneath the hull planking at 7 *a*; 8) A branch of oak (*Quercus cerris* type); the bark is still present; both ends are cut, one is faceted.

Hull recording by underwater Tracings

The Punic hull was actually traced underwater. As soon as one area of it had been cleared of both the ship's contents and its ribs, a large sheet of transparent polythene would be laid down and onto it would be traced every detail of the planking, dowels and scarphs, as well as the remains of the nails that had held the ribs. Meanwhile the ribs themselves and the other timbers that had been lifted, were drawn full-scale on land. Both tracings and drawings were then reduced photographically to a manageable size; we adopted two scales: 1 : 5 and 1 : 25. Without more ado, a model-maker could use a set of reductions as patterns for carving miniature ribs and planks. Once he set the ribs up on the keel, the planks could be fitted over them, nail-hole to corresponding nail-hole (see fig. 8).

The time factor

Before describing the other uses of the full-scale tracings, I should stress how quick and easy they are to make. It took only 4½ hours (spread over three seasons) to trace the hull. Six sheets of polythene varying between 2 m. × 1.50 m. and 3 m. × 2.60 m. were sufficient to cover its port side. What remained of the starboard side was overhung, the ship having listed to port, so these mirror image strakes were drawn on land. Each of the six tracings took, on average, three quarters of an hour to make; this includes the relatively time consuming preliminaries.

Each area had first to be cleared of the film of sand which inevitably resettles on top of excavated wood. A large and loosely folded sheet of polythene was then deployed, stretched until taut and the edges secured with lead weights or sand-bags. Sometimes a protruding nail or lump of putty would prevent the polythene from lying flat; when this occurred a hole was cut round the protuberance so that the polythene fell back into contact with the planking. When all was ready, two divers (always Peter Ball and myself) starting at opposing ends of the polythene, would work towards each other tracing the planking with wax crayons as they went. Whenever a break caused a difference of level between two planks, this too was recorded on the tracing. White or yellow crayons show up better underwater then the dark colours. Before the tracings were passed on to the photographer for reduction, the crayon lines had to be strengthened with black chinograph.

The time spent on underwater tracing is minimal by comparison with the alternatives: making measured drawings and a photographic mosaic coverage. On deep water sites where divers are limited to a quarter of an hour or twenty minutes, tracing-time can be further reduced in several ways: one team of divers can lay the polythene and another take over from them to do the tracing. The size of individual tracings can be reduced to one square metre without loss of accuracy.

The reader might object that such tracings cannot be a complete record of the hull because they are made after its ribs have been removed, but the reverse is true. The imprints of the ribs show clearly on the planking and, more important, so do the nails that held them. When it comes to either model-making or the eventual rebuilding of the hull, it is the corresponding nail marks that show how the ship's skeleton should be fitted back into its skin (see fig. 10).

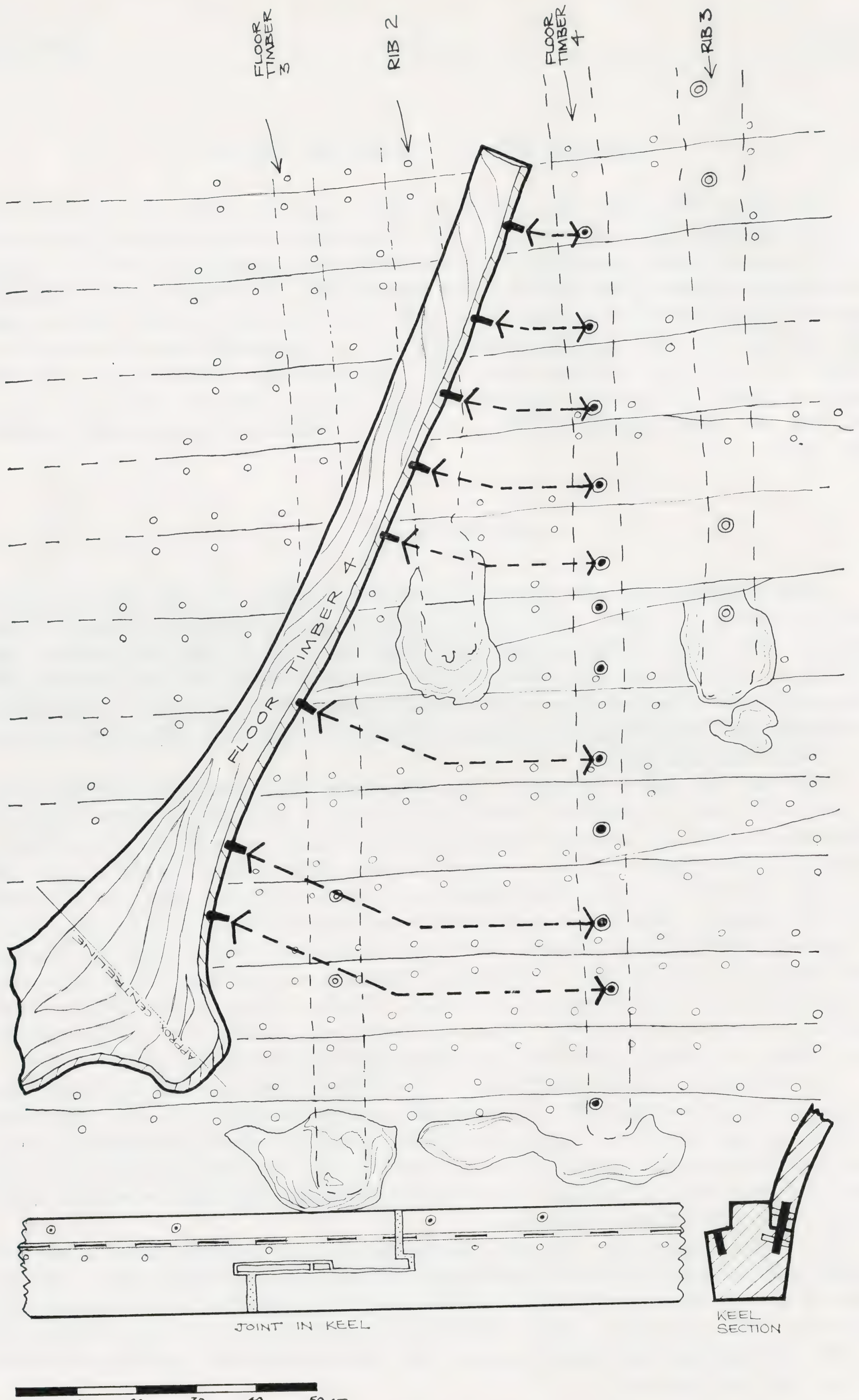


Fig. 10. - Detail of one of the tracings of the hull (made underwater, onto sheets of polythene); superimposed is a floor-timber showing how by matching the nail-holes, a model-maker can make direct use of this type of record. At the bottom, also shown diagramatically, is an elevation of the keel (note its elaborate scarph) and a section through keel and garboard. *Drawing by Peter Brachi.*

Plank drawings supplement tracings

On land the dismembered planking had to be redrawn. These more detailed individual drawings complement the original tracing of the hull, but they are no substitute for it. Apart from correcting distortions caused by irregularities on the seabed, they provide additional information. It is, for instance, necessary to record the sections of individual planks, because the angles of their edges vary in accordance with the distance of each plank from the keel. Further, in this particular wreck, the garboard strakes were sculpted, i.e. cut in a curve by an adze and not sawn like most—but not all—the other planks. When planks 12 to 16 were raised, they were found to be bevelled on the outside so as to provide a system of spray-deflectors round the hull at the water-line.

Other uses of tracings: dismembering a Hull

Hull tracings have innumerable uses at every stage of an excavation; only two need be mentioned in this section. First, tracings are essential for the quick identification of planking once it bas been dismembered and raised. It is not enough to number each scrap of wood before it reaches the surface in the hope that after a lapse of several years this will be a sufficient guide to the physical reassembly of the ship. Nor should it be imagined that the best way to dismember a hull is to cut it into sizeable and regular sections. Cutting always involves some loss of substance and after reassembly, cuts will show as straight lines that are difficult to disguise, whereas broken wood can be joined almost invisibly.

The disadvantage of breaking planking at its weakest points is, however, the resultant irregularity and shapelessness of the pieces that will range from a few centimetres to lengths of 3 metres or more. This hull was raised in 40 sections of which many have since multiplied because, for purposes of conservation, it was expedient to reduce the size of some of the larger. To reassemble them by reference to the wood registers alone, would be time consuming, but because each section as it was raised was marked onto the tracings, the latter serve as a chart whereon fragments can be identified at a glance.

I need hardly add that in most places there is no practical alternative to dismembering a wreck. Though it would be quite easy to raise a hull without breaking it, it would be well nigh impossible either to transport it safely to a laboratory, or to build a large enough " doubleboiler", heated treatment tank to hold it.

The second major use of hull tracings is as adjuncts to making the conventional, expository type of plan such as fig. 9. This is usually possible because large portions of most hulls flatten out as they become waterlogged. It is unnecessary to re-draw them; all that needs to be done is to check, by conventional methods of surveying, which parts of the hull lie on a horizontal plane and which do not and then incorporate the appropriate parts of the tracings. How this is done is described below.

The Base-line

Having been apparent from the outset that the hull tracing was going to be the major record, the rest of the surveying became a means of coordinating the contents of the wreck with the hull itself. The seabed being both flat and horizontal, this was done by trilateration from fixed points and by using a mobile lm. sq. frame for making drawings of the smaller artifacts wherever they occurred.

The first step was the establishment of a baseline that would serve throughout the years of excavation. Base-lines should correspond as closely as possible with the line of a keel

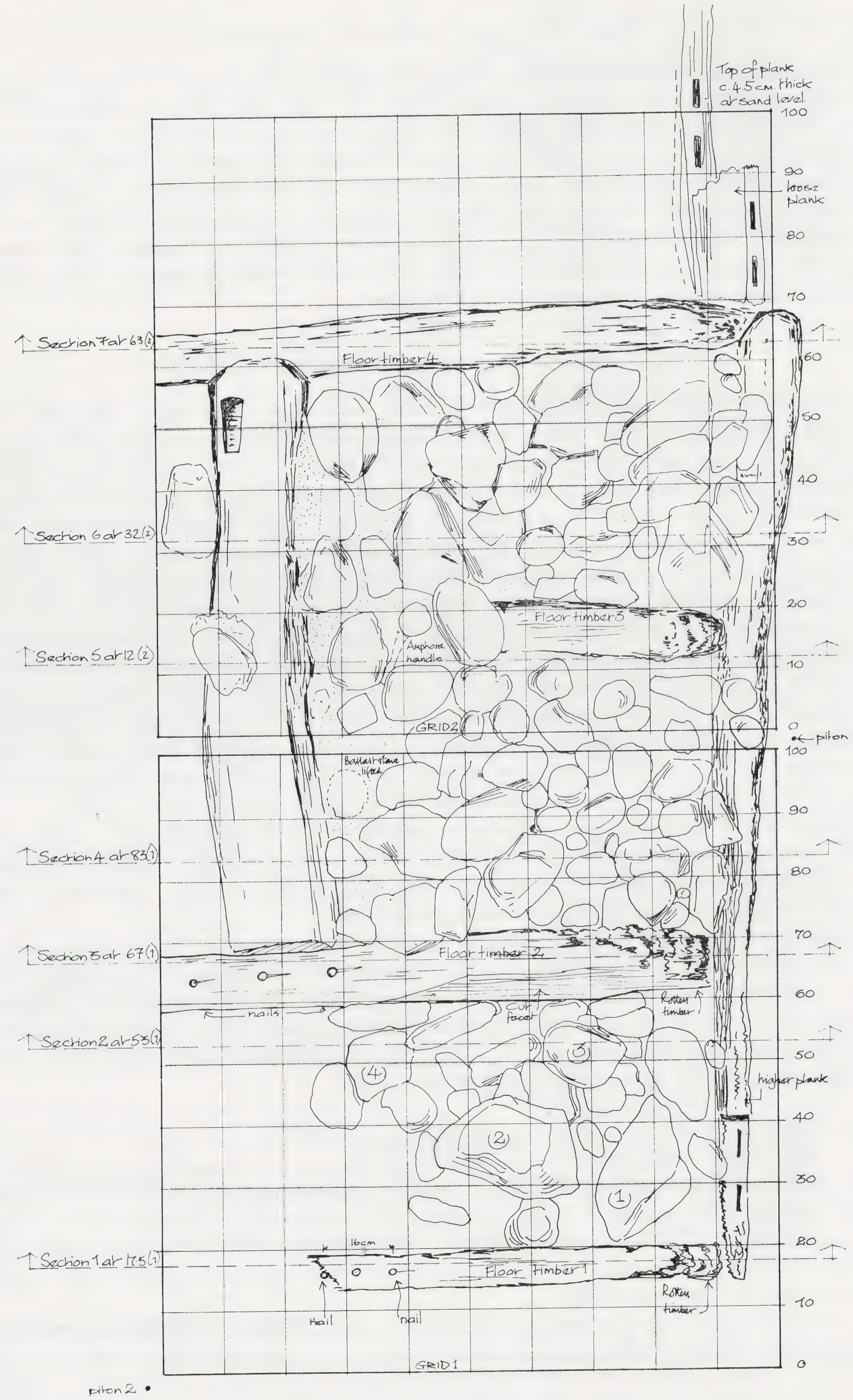


Fig. 11. – Examples of 5 successive grid-plans drawn by Mary Anderson in 1971 (scale here shown as 1 : 10). They cover the excavation of the part of the keel-cavity corresponding to the area OP 14 shown on the general distribution plan fig. 73.

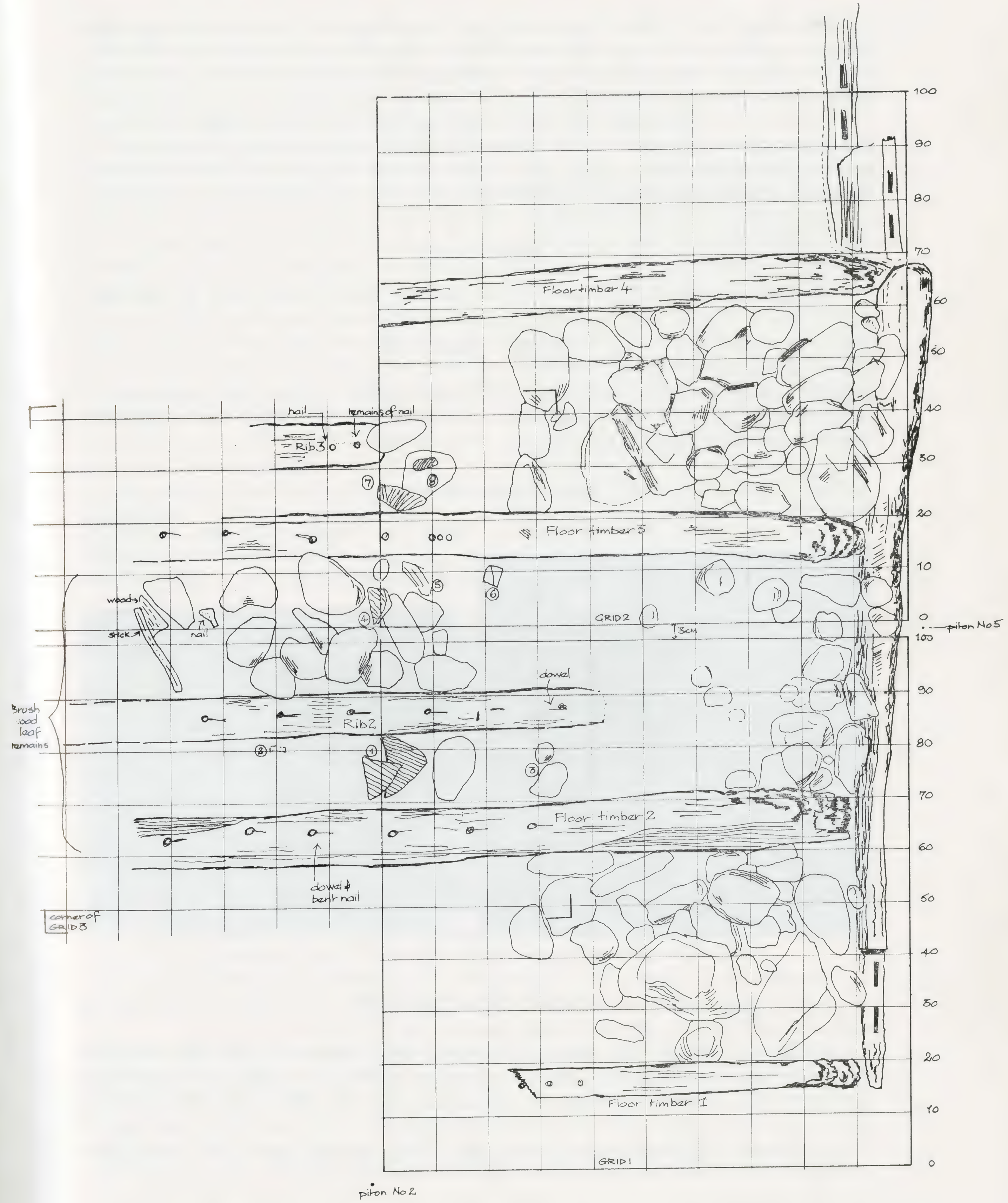


Fig. 12. – The sections (not illustrated but listed on the left of fig. 11) were made with the first template that was designed to fit over the grid frame; later its design was improved as shown on fig. 14.

and their extremities be placed beyond the significant wreck area, but since this operation has to be carried out while the major part of the wreck is still buried, it is fraught with peril. Should artifacts be found later under one extremity, the base-line will have to be extended (to the detriment of subsequent surveying); fortunately our estimate turned out to be right.

Two concrete blocks were cast: each weighed 100 kg. and had an upright 80 cm. iron rod protruding from the centre. The blocks were placed 39.36 m. apart (rod to rod) and a nylon cord stretched between them; when need arose a metre tape could also be stretched between the rods to provide an instant check on measurements along the line of the keel.

Fixed Points

This base-line was supplemented by conveniently placed fixed points, in the shape of iron rods or pitons. The two principal pitons were situated beyond the hull proper, to either side of the base-line on the seaward slopes of the port and starboard ballast piles. Beyond the central area it was sometimes necessary to implant supplementary pitons, but usually one of the base-line blocks and a similar block from our three point mooring system would suffice. Groups of small objects were, of course, drawn in detail with the aid of the mobile freestanding frames.

Mobile drawing frames

These 1 m. square frames graduated in decimetres, had adjustable legs, so that by using a spirit-level the frame could be set at the horizontal. Objects thus framed were located by means of a mobile cross-bar (also graduated in decimetres) and a rigid " plumb-line", fig. 13 (1).

Fig. 13. – A 1 m. square frame (graduated in d/m) as used for making detailed phase-plans of the small finds (note the spirit level used for setting it).

The drawings were made on white perspex tablets onto which had been ruled a 1 : 5 replica of the frame's grid (see finished examples fig. 11 e 12).

Every time a frame was moved measurements taken between its legs and the above mentioned fixed points would be noted on the tablet, so that eventually each " grid-drawing " could be positioned on the master plan of the site. The method proved accurate; in

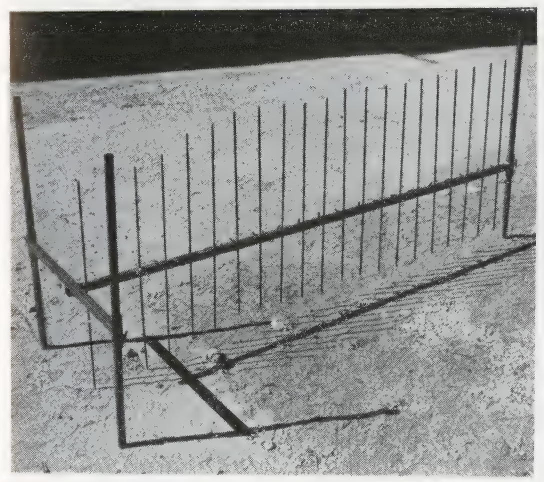
(1) F. Dumas, *Deep Water Archaeology*, Routledge and Kegan Paul 1962, pp. 59-61; H. Frost, *Under the Mediterranean*, Routledge and Kegan Paul 1963, p. 178-80 and pp. 184-5.

any case the hull itself was always used as a cross check, because most of the " grid-drawings " contained part of the ship's structure, so the slightest divergence between two contiguous grid-drawings would immediately be apparent. If, for example, two ribs shown in one drawing did not correspond with the same two ribs represented in an adjacent drawing, the measurements would have to be rechecked and the error corrected.

On land the drawings were transferred from the tablets to sheets of tracing paper and positioned on the master-plan. Thus a mosaic was built up, that showed the wreck at every phase of its excavation. The advantage of the system is its flexibility. It allows excavation to proceed according to the exigencies of the site. One or more draftsmen can work at the same time as the excavators. If delicate material such as rope is suddenly uncovered, a grid can immediately be positioned over it and a drawing made. It is these drawings that show the relationships of the artifacts to each other, and to the hull itself.

Measuring sections

In theory, this frame can always situate objects in three dimensions, because like the sides and cross-bar, its rigid " plumb-line " is also graduated (but in centimetres rather than decimetres). In practice, constant three dimensional recording was as unnecessary as it was time-consuming. Nevertheless, sections being desirable in principle, we built in 1971 another attachment for the grid that would measure them more quickly than the " plumb-line ". This too took the form of a cross-bar, but with metal rods passing through



a

b

Fig. 14. – *a*) The improved template used for taking sections; *b*) the template in use, underwater, measuring the 7° slope of the keel.

it. Once it had been fitted across the grid-frame the rods were depressed so as to touch the objects beneath them. They were then secured in this position by tightening the screws that controlled them. The comb-like attachment was then handed up to the architect in the boat above who recorded the section, relating it to the plan (note the list of sections on fig. 11). The system worked, but it was apparent that the design "of the comb" could be improved.

Though the fortuitous tumble of the crew's effects hardly warrants constant measurement, sections are needed where the curve of a hull is preserved. For those unfamiliar with submarine excavation, it should be explained that slopes are not noticeable underwater where there is no horizon; even the force of gravity is so reduced that things do not "roll downhill" as on land. Consequently it is better to err on the safe side by taking a maximum of sections. In 1971 dozens of transverse sections were measured with the "comb". By the 1972 season, Peter Ball had designed and built an improved template with which we again made quantities of transverse sections even supplementing them, inside the keel cavity, by detailed measurements taken with a flexible lead strip. None produced information that had not already been deduced from the drawings of the floor timbers themselves. The longitudinal sections showing that the keel had a slope, did however prove highly significant (figs. 14 *a–b* and 15).

Fig. 14 *c*. – "Photogrammetric cross" (graduated in dm. and measuring the diagonal of a 1 m. square); all that is shown in this photograph can be converted into a true plan by proliferating grid squares based on the tips of this cross.

The Slope of the Keel

The slope might have passed unnoticed had it not been actually measured, and without this information we would not have known how the ship sank, or been able to interpret the distribution of its contents.

The longitudinal sections showed the keel to lie at an angle of 7°. The depth being 2,50 m. and the length of the ship in the order of 30 m. its prow, which on sinking must have protruded above the surface, had probably been destroyed by the waves. The fact that the stern had remained firmly stuck at this extraordinary angle for over 2000 years, implies that it had been driven into the seabed by some unnatural force such as ramming, otherwise had one wave been strong enough to lodge such a large ship in this position, another would surely have been strong enough to dislodge it again. The full significance of the finding will be discussed; here it is sufficient to point out that without a suitable instrument, the discovery might not have been made.

The Tripod Template

The instrument in question is a metal template consisting of a beam 2 m. long, which can be set in a horizontal plane (using a spirit level) by altering the lengths of its three adjustable legs. As with the "comb", a section is taken by depressing the rods that pass through the beam at 10 cm intervals, until each touches the surface to be measured. The lengths of the rods are then recorded on a prepared tablet and the information is passed to the architect on land who coordinates it with the master-plans.

Notes on Datum Points

On this atypical wreck, the keel served as the datum, the transverse sections being taken at right angles to it and at set intervals. The method would probably be impractical on most other sites. In deeper water no particular difficulty attaches to fixing a datum level. Assuming a flat calm sea, its surface is the obvious datum, but since the sea is never completely calm, a point can be fixed at a convenient level above the seabed by means of a waterfloat. The principle involved is that a corked bottle containing water as well as some air, will float below the surface. By adjusting the proportion of air to water, its height above the bottom can be regulated. The same principle can be applied to make an instrument using coloured water inside a transparent, flexible and therefore mobile hose. On a shallow site within the influence of the breaking waves, this principle cannot be used: but again the kind of information required of the Punic Ship made it unnecessary.

Photography

The advantages of photographic plan-making are directly related to the time element and underwater, this is always restricted to a greater or lesser degree, but being in shallow water we did not have to rely on the camera for surveying. In any case photogrammetry whether mechanical or graphic, produces plans and no plan can rival the nail to nail accuracy of life-sized tracings of a hull. In a full excavation, as distinct from a quick survey, it is obviously better to take measurements rather than to have to work them out later from a series of photographs. Nevertheless two cameras (Calypsophot and Niconos) one with black and white and the other with colour film, were always kept on the bottom for general use. A third camera with a close-up lens, was held in reserve.

The site being exposed, the water was usually cloudy. For example, despite the shallowness, only once in four years, was it clear enough to photograph the wreck from the boat above it! Underwater, long shots were seldom feasible. The main uses of the cameras were:

1) to make record photographs serving as *aide mémoires*; as supplements to the log book and registers of finds, and acting as cross checks to the grid-drawings.

2) to make a general coverage of the site at the beginning and end of each season.

As a precaution, an aid to graphic photogrammetry was, however, introduced during the general coverage and in other long shots of the wreck. This instrument is a graduated metal cross fig. 14 *c*, each bar being the length of the diagonal of a one metre square. When this cross is present in a photograph, or a series of photographs, these can always be converted into true plans by using the system described by J. C. C. Williams (2).

(2) J. C. C. Williams, *Simple Photogrammetry*, Academic Press, London and New York, 1969; H. Frost, *On the Planning of vast and partly Submerged Harbour works from Aerial and Underwater Photographs*, in *Surveying in Archaeology Underwater*, Colt Monograph 4, Quaritch, London, 1969.

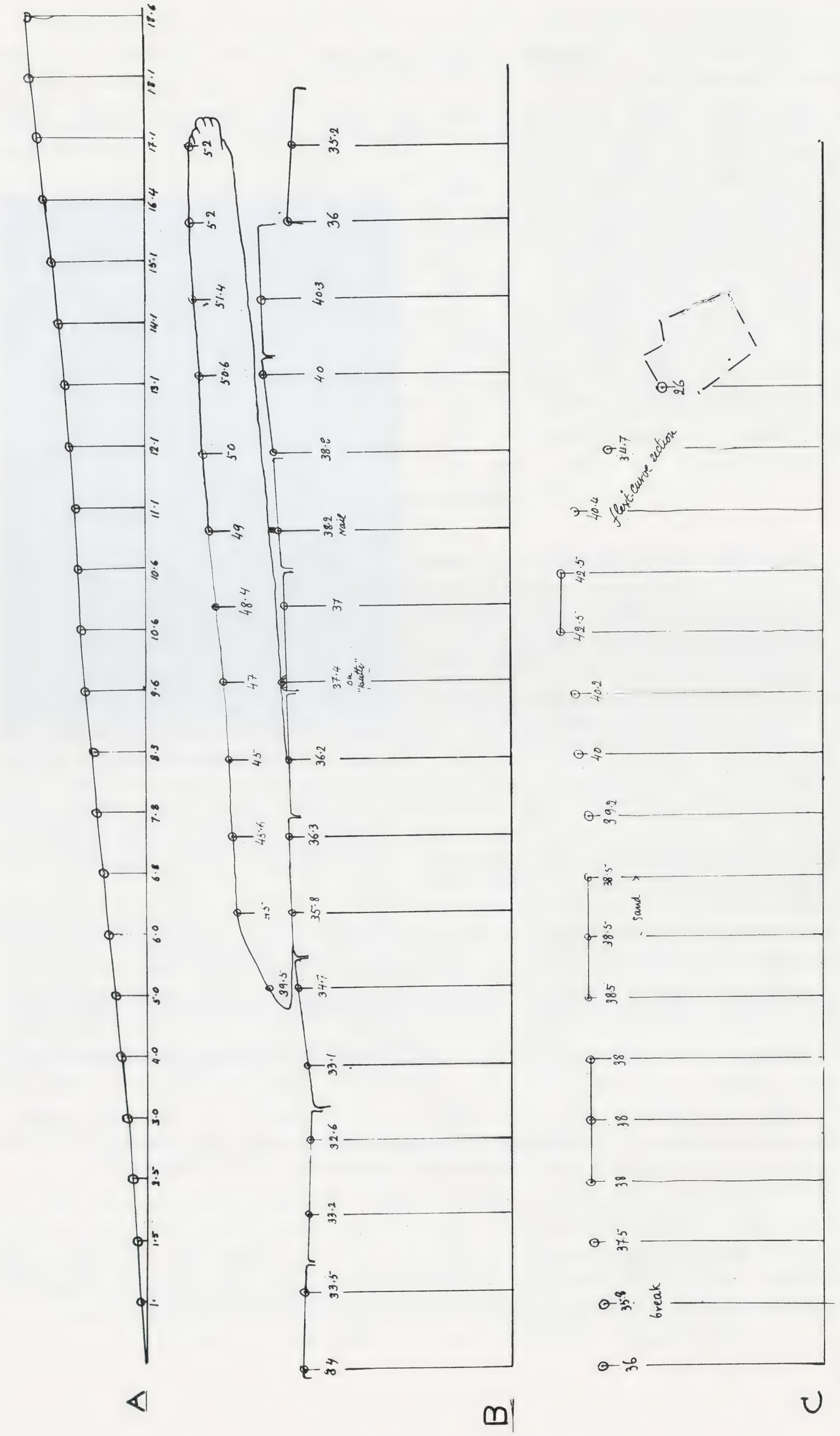


Fig. 15. - An example of one of the sections measured by means of the comb-like template: A) K 3 longitudinal section; B) Sections on Rib 8 or "K"; C) Section at Rib to K4, between $\sqrt{3} + \sqrt{4}$ (1971).

Photographing the Painted Signs

Only one unusual photographic problem arose; the recording of the shipwright's signs. These had been painted in a watercolour pigment that not only brushed off when touched, but faded on exposure to light. Once faded, the signs could sometimes be seen again, on land, under the ultra violet and infra red light of a cosmetic sun-lamp. This fading of the signs which occurred in a matter of minutes, came as a surprise. Once we understood its cause, expert advice was sought and the most suitable type of ultra violet lamp was bought. Though it worked excellently when tested on panel paintings, the lamp proved ineffective on the signs. After many experiments, the most successful photographs of their ghostly remains were taken in strong sunlight by Dr. William Johnstone, but his tracings of the signs remain the best record.

Such signs must inevitably be recorded on land, because many of them will occur on the undersides of timbers so that they will remain invisible until the timbers have been raised. Because of the fugitive nature of the paint it will, however, be as well to make special provision for photographing those signs that can be seen underwater. Although painted signs were discovered for the first time on this wreck, I cannot believe that they do not exist on other wrecks. To be forewarned is to be forearmed. Henceforth the search for them should be programmed as a distinct operation, and to this end a camera with a flash rich in ultra violet light should be held in readiness underwater where, the paint being newly exposed, the ultra violet should prove effective.

Coordinating the Catalogue of Small Finds on Land

On all bona fide wreck excavations the lifting of pottery and small finds has become so standardized, that little need be added. Usually plastic tags are attached to amphorae on the seabed while the objects are being recorded within the numbered squares of a grid. On this wreck where no permanent grid-coverage had been erected and where the average find measured only a few centimetres the procedure was modified: the mobile grid-frames described above being used. After the drawing (based on this frame) had been made, a diver would put his finds into plastic bags each with a label on which he wrote his name, the date and the location.

On return to base, each diver would hand his bags to a waiting archaeologist. The latter entered the finds in the Register, giving each a consecutive catalogue number and, if necessary, re-checking the provenances with the diver. Meanwhile the objects themselves would be placed in freshwater storage tanks still in the same plastic bags with the same labels, to which the catalogue number had now been added. After soaking for three weeks, the pottery would be dried then be numbered in ink in the usual way.

Plaster casts as records of Wood

As with the dismembered timbers, the small finds were drawn and photographed on land as a matter of routine. The three dimensional recording of the most important part of the ship's structure, its stern, is however an innovation which deserves comment.

Plaster casts were made of the maple wood rise of the keel, a section of the keel proper, the four aftermost floor-timbers and a short longitudinal timber (intended to carry an upright support for part of the superstructure).

The casting of this fragile wood was a straightforward if highly skilled job. We were fortunate in the collaboration of a sculptor, Prof. Salvatore Ando of the Palermo Museum. He made the casts himself during the first season. Later, he was kind enough to teach the expedition's conservator (in 1972, Miss Tania Erlij) how to continue with the help of other members of the team.

This replica of the essential parts of the hull is of course an insurance against any possible disaster that might occur to the original wood during its lengthy treatment. On many ship excavations where no conservation laboratory has been built, or where only one or two elements of a ship's structure are sufficiently unusual to warrant display space in a museum, casts of the unusual timbers would appear to be the logical solution to both problems. In addition, casts fulfil several less obvious functions.

Waterlogged timbers are not only notoriously difficult to handle, but they are inaccessible during the years that they remain either in storage or treatment tanks. Meanwhile the theoretical work on the architecture of the ship will be continuing and, despite elaborate drawn records, it will be useful to be able to refer to the actual shape of a wooden component. Further, specialists in naval archaeology will at all times be able to study structural details which will once more become invisible when the ship is reconstructed and planking again clothes its skeleton.

Finally, there is the problem of discolouration. As already noted, both the natural colours of the woods and the shipwright's painted signs tend to disappear soon after excavation—a process which is completed by the conservation—for no remedy is known for the darkening of timber after its impregnation with synthetic wax. Both the colours and the tracings of the painted signs can, however, be reproduced on the plaster casts.

This has been done at Marsala, where the stern of the ship (together with photographs of its excavation) are already on display in a hall belonging to the Scuola Media «Vincenzo Pipitone», thanks to the hospitality of its Principal, Preside Giuseppe Pecorella. While the Punic Wars still feature in school curricula, this is the only school where the pupils can examine details of one of the ships that fought in them.

Honor Frost

IV. NOTES ON CONSERVATION

Plant Material

The first and most essential step in the long and varied process of conservation is to prevent any object from drying out before it reaches the freshwater tanks in the field-laboratory. Pottery and metals occur on all wrecks, so that their treatment need not be discussed here, but there is no precedent for the vast amount of astonishingly well preserved plant material, cordage, etc., peculiar to this wreck. Its quantity was embarrassing, because to those working on the seabed, surrounded by 2000 year old plants, each one seemed a little miracle, tinged with the romance of the mummified queen in Ryder Haggard's *She*. They could hardly bring themselves to select the odd sample, then feed the rest by handfuls into the Moloch-mouth of the dredge.

On land the view was different. Boxes even sacks of plants, all subject to decay, would overfill the limited space in our freshwater tanks, and to what end (considering that it was doubtful whether any plant-anatomy laboratory would accept such quantity)? As one archaeologist quipped: " we know what a leaf looks like; we are here to find out what pottery was used on board this ship ".

Nevertheless, information extracted from such material could be useful, if only because the plants must have been picked within walking distance of the place where this ship had been launched, so that they were a clue to its identification. Further, being of only one year's growth, they were the best material for carbon 14 testing, providing that the field-conservator resisted the temptation to dose them with chemicals which would subsequently preclude either this testing, or freeze drying. The prime requisites for the field-laboratory are indeed no more than an abundance of receptacles, of freshwater and ideally, of distilled water as well.

Packing

In dealing with such massive quantities of organic matter our selection policy became a compromise between taking dispensable specimens for testing and representative specimens for conservation and eventual display. In either case, the specialized laboratories that would be involved were distant. Consequently, the second most important step in the conservation of this material was to devise safe methods of packing and transport. Sealed, freshwater containers would not only be difficult to carry in a van, but the objects within them might disintegrate with the movement. The ideal packing was discovered through a chance observation of some ancient timber that had been washed on to the beach where, after months and even years, it had remained perfectly preserved within the piles of *Poseidonia*. The smell of hydrogen sulphide which its leaves gave off leads me to suspect chemical properties that favour conservation. However this may be, the consistency of most seaweeds and the fact that they remain damp for a very long time, make them the ideal packing for wet organic material.

Handling Underwater

There would, however, have been no material to transport, had not underwater routines been devised for its handling. In the sea, after twigs or rope have been uncovered, they can disintegrate at the slightest movement in the surrounding water. The smaller, lighter objects, such as string and leaves, are relatively easier to handle than ropes. The former can be supported on a fine net stretched over a wire frame and so transferred to containers which are then closed underwater. Rope needs complete support; raising it within the sand that surrounds it merely transfers the business of cleaning from the seabed to the laboratory. Alternatively, slipping a rigid metal or plastic tray beneath the rope, covering this with for instance, a bag filled with *Poseidonia* leaves then draining off the sand from the edges of this " sandwich ", is probably the better solution.

In the field laboratory, it was not until Miss Fiona Campbell joined the expedition in 1974, that this kind of material was washed with complete success. Being familiar with the treatment of rare books, she applied the same techniques to the plant material: moving the leaves and string about on blotting paper slipped under them in the tanks, and effecting the periodic changes of water by a judicious use of pipettes.

Embedding

Once free of salt, the string and leaves could have been conserved in the same way as the larger objects, but because they were so small and intrinsically fragile they would still have been at risk. It was Austin Farrar, the naval architect, who conceived the idea of embedding them in transparent plastic. This also introduced an element of design, so that the otherwise insignificant looking scraps of material took on a life of their own. John Wood continued the embedding, designing various displays; massing *Cannabis* stalks so that thay could eventually be shown over a replica of the basket that had contained them, putting olive stones into a saucer shape that could fit into one of the pottery dishes from the wreck, arranging a selection of plaited strings in the mount that would hold the marlin spike and putting twigs representing ' Punic dust ' in the base beneath the little brush or besom (see figs. 22, 26, 33 *b* and 42).

The only disadvantage encountered in the embedding was a darkening of the *Phillyrea* leaves on contact with the plastic; the cause of this reaction should be found and rectified before further embedding is attempted.

Freeze-Drying

The besom, marlin spike, wooden toggle and rope samples, as well as certain twigs and logs were stabilised by freeze-drying by Mr. R. H. Harris (of the British Museum, Natural History), before being treated with paraloid by the conservator Mr. Michael Kailas (see figs. 25, 32, 38 40 and 42). Other plant material is being treated together with the hull timber, with polyethylene glycol (see below).

Freeze-drying effectively arrests decay, without causing colour changes, but the objects remain fragile and susceptible to atmospheric humidity, hence their need for further treatment. In the case of the ropes and " broomstick ", the colours had already darkened before the objects were freeze-dried. When Michael Kailas took over the treatment, using his experience as a restorer of panel paintings, he combined bleaching with the gradual impregnation with paraloid.

His skill was put to the severest test by the besom. This was the only find which, because of its extreme fragility, could not even be washed in freshwater. It was rushed to the freeze-dryer within 48 hours of being lifted. The result was that the salt it contained continued to rise to the surface in crystals which had to be picked off with tweezers over a period of 6 months. The besom's shrinkage was considerable; its overall size was reduced by almost one third, whereas the " broomstick " which had been washed before receiving the same treatment, still corresponded with its original measurements. But considering that any small brush is fragile and the fact that after 2000 years immersion this one's fibres had been reduced to powder, it is a great tribute to its conservator that it survives at all.

Timber Conservation: Choice of Method

At the time of writing, the conservation of this ship's dismembered timbers is nearing completion and it will soon be possible to start reconstructing the original hull. It is extremely rare that the main aim of wreck excavation should be the reconstruction of the ship, but this being so in our case, it governed the techniques we used from the outset. A brief description of the hull conservation is therefore justified in this excavation report.

There is, as yet, no universally applicable recipe for treating huge wooden artifacts such as ships. Many processes, like freeze-drying, that are applied in laboratories to small pieces of waterlogged wood are impracticable, because the apparatus involved has never been built on a scale sufficiently large to take a ship. Were it to be attempted, such highly skilled personnel would be required for its construction, maintenance and operation, as to put the undertaking beyond the means of most archaeological budgets. Further, though there are processes such as freeze-drying that have the advantage of preserving the original colour of wood, they tend to render it brittle; thus, if planking has become distorted in the course of waterlogging, it will be impossible to bend it back into its original curve after certain treatments.

To date, the best-tried method that is also practicable on a large scale, is impregnation with the hydrophile synthetic wax; polyethylene glycol, or "PEG". Timber thus treated can be subjected to torsion, but its natural colour will inevitably be darkened. The success of the PEG treatment depends on a combination of factors such as: the rate at which the impregnation is programmed, temperature control, the choice of a molecular weight of wax suited to the individual soft or hardwoods, to their state of preservation etc.

If a ship has been raised intact, as in the case of the large oak-built " *Wasa* " in Sweden, then the wax solution will have to be sprayed onto its surface, because it would be out of the question to construct a heated treatment tank large enough to contain the entire hull. But if a ship is built, like most Mediterranean craft of the classical period, of several different kinds of wood and of planks and timbers of varying thicknesses, then its individual parts may need to be treated in different ways and even with different molecular weights of wax. This is an argument in favour of disemembering a ship during excavation and only reconstructing it once its parts have been conserved.

Such was the method successfully applied in the first ship-conservation laboratory in the Mediterranea area (at Kyrenia in Cyprus) by Prof. Michael L. Katzev and his staff. We chose to follow his method in the second such laboratory, which we built at Marsala.

Trial Treatments at Palermo University

As early as 1971, samples from the Punic hull had been submitted to Dr. R. A. Munnikendam (Central Research Laboratory for Objects of Art and Science, Amsterdam). On comparing them with samples from the Kyrenia ship, he found ours to be much better preserved. This was bad news, because the more decayed and ' spongy ' the wood, the easier it is to impregnate with PEG. Consequently, when in 1974 the time came to begin treatment, after the Punic Ship's last timbers had been raised and the salt had been leached out in the freshwater tanks in the Palermo Museum, we could not copy Katzev's procedure without first making tests, on a realistic scale, on samples of our own wood. According to the results of these trials, Katzev's methods would then have to be adapted to our needs. The technical details of the methods we eventually adopted are given below, by Dott. Pietro Alagna (p. 50). I will therefore only outline the history of how we arrived at these solutions.

In February 1974, under Prof. Katzev's direction, two galvanised iron double-boiler tanks were assembled and fitted with heating elements and circulation pumps in the *Istituto Coltivazioni Arboree*, Palermo University (1).

The internal measurements of these tanks were respectively: 1.19 × .49 × .70 m. and 1.09 × .29 × .50 m. The larger accommodated four and the smaller three trays, on which were placed representative samples of the various hardwood timbers, pinewood planking, logs from the kitchen area and branches from the dunnage. PEG of the larger molecular weight of 4000 was used in one tank and the smaller molecular weight of 1200 in the other (2).

After four months of treatment (as programmed by Katzev), tests were carried out to ascertain firstly, which molecular weight of wax had given the best result; secondly, when the wood was likely to be sufficiently impregnated to be removed from the tanks. It was Miss Frances Talbot, conservator of the Kyrenia Ship, who in June 1975, kindly made the journey from Cyprus to Palermo to direct this work. The actual testing was carried out by Dott. F. P. Tartaglia of the *Istituto Chimica Agraria*, Palermo University (who thereafter continued to perform all the routine testing).

Eventually the wood was transferred to the newly built Marsala Laboratory (see fig. 16) and the small treatment-tanks were installed there alongside the new stainless steel tanks described below by Dott. Alagna. Meanwhile, although all the wood from the first trials had been equally well impregnated with hot wax, there was a marked difference between the surface in the two sets of samples. Those that had been treated with wax of the smaller molecular weight remained soft and sticky to the touch. In the

(1) I am deeply grateful to Prof. Michael L. Katzev for coming to Palermo and for his untiring and expert help; also to the American Institute of Naval Archaeology for enabling him to make this journey. For arranging that the experiment should be carried out in the *Istituto Coltivazioni Arboree*, warmest thanks are due to Prof. Giuseppe Donato, Director of the *Programma Speciale Scienze Sussidiare dell'Archeologia, Centro Nazionale delle Ricerche*, and to his collaborator Dott. Dario Monna who had these first tanks built and transported to Palermo; both made journeys to Sicily on this account and were in every way generous in their help. For the hospitality of his Institute, I am beholden to Prof. F. G. Crescimano, and for carrying out the programme of treatment to members of his staff, especially Drs. Nicasio Tusa, Francesca Barone and Fabio di Pasquale.

(2) We thank Mr. M. J. Lappert in London and ShellChimica Italiana of Genoa for their gift of 300 kg. of PEG 4000, also Inj. Giunio Santi of Sub Sea Oil Services and again Shell Chemical for the subsequent gift of another 300 kg. of PEG 1200.

Marsala Laboratory, this wood had been laid out on a hard white surface where, after two months I noticed that wax had oozed from the sticky set of samples, forming pools around them. A sudden change in atmospheric humidity had drawn it out of the surface of the wood, whereas the PEG of the larger molecular weight of 4000 had not ' leaked '. I therefore placed the offending samples in a bath of decalcified water to leach out more surface wax, before retreating them in PEG 4000: this produced a satisfactory hard surface.

It was this corrective treatment that, later, provided us with the solution to an unforeseen problem, namely the unsatisfactory reaction of maple wood to PEG 4000 (see Alagna, p. 50). One of the successfully re-treated samples had been a fragment of a large maple wood floor timber. But the major part of this timber later suffered cellular collapse because

Fig. 16. – The freshwater storage-tanks in the courtyard of the Palermo Museum; wood is being loaded onto a lorry for transfer to the Laboratory at Marsala.

the PEG 4000 in which it had been treated had not penetrated to the centre of the timber (as the PEG 1200 had done on the small sample). We did not discover this surprising phenomenon until after the first batch of wood had been treated in Marsala, but fortunately there had been only this one maple wood timber in the large tanks. Thereafter everything made of maplewood was given two treatments the first in PEG 1200 and the second in PEG 4000 to consolidate its surface.

The overwhelming evidence of the first tests did, however, indicate that PEG 4000 was the best molecular weight to use on our wood. Consequently, 5 tons of this wax (some of it new and some recycled) were bought from the stock that had been left over after the treatment of the Kyrenia Ship. The volume of wood from the Punic wreck beng greater than the volume in the small Kyrenia Ship, 5 tons were insufficient to treat all our wood at one and the same time. But to have attempted to conserve our ship in a single treatment would not have been practical for other reasons, such as lack of space and personnel. One of the most time-consuming jobs is, for instance, the preliminary cleaning of the wood after its removal from the tanks. In our case this had to be performed by as few as four persons,

visiting Marsala for only two months in the year. The treatment of our wood was therefore programmed in three successive batches, the wax being recycled after each use.

The new treatment tanks were designed accordingly and the first batch of wood put into them in September 1975. The treatment of the last batch will begin this summer, 1977. Such are the broad outlines; the exceptionally efficient realisation of this scheme is entirely due to the collaboration of Dott. Alagna, who contributes the following technical note on its details.

HONOR FROST

NOTA A PROPOSITO DELLA CONSERVAZIONE DEI LEGNI A MARSALA

In seguito alle prove fatte sui campioni dei legni recuperati, presso la Facoltà di Agraria dell'Università di Palermo e con la collaborazione del Prof. Michael L. Katzev, è stato scelto il polietilenglicol 4000 (sigla PEG) per il trattamento con un metodo particolare in relazione ai legni della nostra nave.

È stato all'uopo realizzato un laboratorio con le caratteristiche tecniche necessarie al metodo adottato.

Le limitate disponibilità finanziarie ci hanno costretto ad adottare le soluzioni più economiche sia come spese d'impianto che come spese di gestione tenendo presente il lungo periodo nel quale si deve agire.

Il laboratorio risulta essenzialmente così costituito:

1. N° 2 vasche rettangolari dimensioni $3 \times 1.20 \times 2$ e $3.50 \times 1.20 \times 2$ m. in acciaio inox 304 Aisi rinforzati da profilati in acciaio comune.

2. N° 2 vasche rettangolari in lamiera di ferro aventi dimensioni tali da contenere le due precedenti in acciaio inox, isolate termicamente con pannelli in lana di roccia. Le vasche in acciaio sono state ancorate alle vasche in ferro che le contenevano in modo da impedite il galleggiamento.

3. Impianto di riscaldamento formato da:

a) caldaia con bruciatore a gasolio di piccola potenza normalmente adottata per impianti di riscaldamento a termosifoni in piccoli appartamenti.

b) N° 2 pompe di circolazione con funzionamento alternativo.

c) termostato per la regolazione della temperatura da 20 a 90° C.

d) Serbatoio gasolio con tutti i dispositivi di sicurezza antincendio.

e) N° 2 pompe per la circolazione della soluzione PEG dentro la vasca. Sono state adottate delle comuni pompe per impianti di riscaldamento casalingo di bassa potenza e di poco costo.

f) N° 1 termometro, montato sulla vasca N° 1, a quadrante con contatti elettrici regolabile alla temperatura voluta, raggiunta la quale determina il fermo in tutto l'impianto di riscaldamento.

g) N° 1 termometro a quadrante con contatti elettrici accoppiato ad una valvola a solenoide per l'interruzione della circolazione dell'acqua calda nella II^a vasca (ciò è stato previsto onde avere la possibilità di fare dei trattamenti a temperature inferiori a quelle della prima vasca).

h) tubazioni in ferro per il collegamento della caldaia con le vasche in ferro e tubazioni in acciaio zingato per la circolazione del PEG.

i) termometri per il controllo dei termostati.

Tutta questa attrezzatura serve a mantenere la soluzione di PEG a temperatura costante e a consentire un graduale aumento di essa secondo il metodo stabilito.

Nelle vasche in acciaio inox abbiamo collocato la prima grande serie di legni cosi divisi:

a) legno di pino (fasciame e una parte della chiglia);

b) legno duro (travi);

c) rami, ramoscelli di diverse essenze arboree e arbustive (legna da ardere in cucina e da servire per cuscinetto tra la zavorra e il fasciame).

Questi legni sono stati immersi in una soluzione di PEG 4000 al 15% in acqua decalcificata, con circolazione forzata, e riscaldata all'inizio a 32° C. Si è deciso di far durare il trattamento 250 giorni e di raggiungere alla fine la concentrazione dell'80% in volume mediante l'aggiunzione giornaliera di un quantitativo calcolato proporzionale di PEG 4000 e aumentando la temperatura di 2 gradi per ogni 15 gg. fino a raggiungere i 60° C.

Si è eseguito ogni settimana il peso specifico della soluzione onde tracciare successivamente il grafico. Si è mantenuto costante il livello della soluzione favorendo o limitando l'evaporazione, attraverso spostamenti, della copertura in legno.

Tutti questi legni hanno reagito bene al trattamento tranne l'acero (*Acer*). Infatti una costola e una madiera di acero si sono deformate subendo uno schiacciamento delle superfici piane così da trasformarle in concave. Ciò fa supporre una rapida perdita d'acqua d'imbibizione dal centro del legno con conseguente afflosciamento cellulare.

È stato notato inoltre che pezzi d'acero che precedentemente, nelle prove eseguite a Palermo, erano stati trattati con PEG 1200, con un nuovo trattamento al PEG 4000 non si sono deformati mentre hanno assunto un migliore aspetto peculiare dei legni trattati con PEG 4000.

Marsala, Settembre 1976.

PIETRO ALAGNA

V. DIET: BONES AND VEGETABLE MATTER

Meat Bones

The animal bones on the Punic Ship imply that its sailors lived like fighting cocks on a high protein diet; their drinking habits were interesting, if more conjectural. This contrasts with apparent undernourishment on board other ancient ships, for there is no record of bones on the Congloué or the Chrétienne C, though fishing tackle was found on both sites (see chapter on metals). The Nemi ships were, of course, atypical being ceremonial barges, but nevertheless some evidence of snacks or sacrifices might have been expected.

On the many other wrecks that have been investigated rather than excavated, large cooking utensils were found, but again, the best indication of what went into them is suggested by the presence of fishing tackle. Otherwise, remains of foodstuffs occasionally occur but it is seldom clear whether they had been carried as cargo or for consumption on board. At l'Anse Cavalière, for instance, one Dressell-type amphora contained olive stones, and another boar's bones and tusks; on the Drammont D, dates were found in a Rhodian amphora and a little jar was filled " with a kind of semolina " (1). This list could be extended, but it would be both unfair and misleading to do so, because for various material reasons it had been impossible to conclude the excavations in question in accordance with land standards.

Complete excavations were carried out by Prof. Bass at Cape Gelydonia (Turkey), and by Prof. Katzev at Kyrenia (Cyprus).

The Gelydonia wreck is, however, not entirely representative because the hull had perished and so, it follows, had some of its contents. There was a single animal bone on the site, a sheep's astragal, which might equally denote either gaming or food. Otherwise, 18 fishing net weights, a line sinker and 3 fish bones, once again support the hypothesis that fish had been the main source of protein (2).

By contrast, the Kyrenia Wreck was intact and the hull in a good state of preservation. Again, it contained no animal bones, but as many as 300 fishing weights. Almonds too were found, but in such quantity as to suggest that they had been carried as cargo rather than for the crew's consumption; as usual there were a few olive stones. The absence of other foodstuffs on this small, 3th century, trading vessel (only 10 m. of keel), leads Prof. Katzev to suggest that, like many of its modern Levantine counterparts, it might have put into shore every evening, where the main meal of the day would have been obtained and consumed (3).

(1) B. Liou (Report), *Direction des recherches archéologiques sous-marines*, in *Gallia* 31, 2, 1973, pp. 590 and 595.

(2) G. F. Bass, *Cape Gelydonia: a Bronze Age Shipwreck*, in *Transactions of the American Philosophical Society* 57, 8, 1967, p.p 133, 134 and 131.

(3) M. L. Katzev, *Resurrecting the oldest known Greek Ship*, in *National Geographic Magazine* 137, 6, 1970, p. 846 and *Cyprus Ship Discovery*, in *Illustrated London News* Archeol. Section No. 2394, June 1974 p. 71.

Surprisingly, a complete cargo of pig's carcasses, each cut in half lengthways through the spine, was found recently by M. Robert Lequément, on a late Roman ship near Marseilles (personally communicated by Dr. François Poplin; see below). Doubtless better comparisons will emerge as soon as the current and promising wreck excavations have been completed and published. Meanwhile, by any standards, the amount of meat on board the Punic Ship was generous.

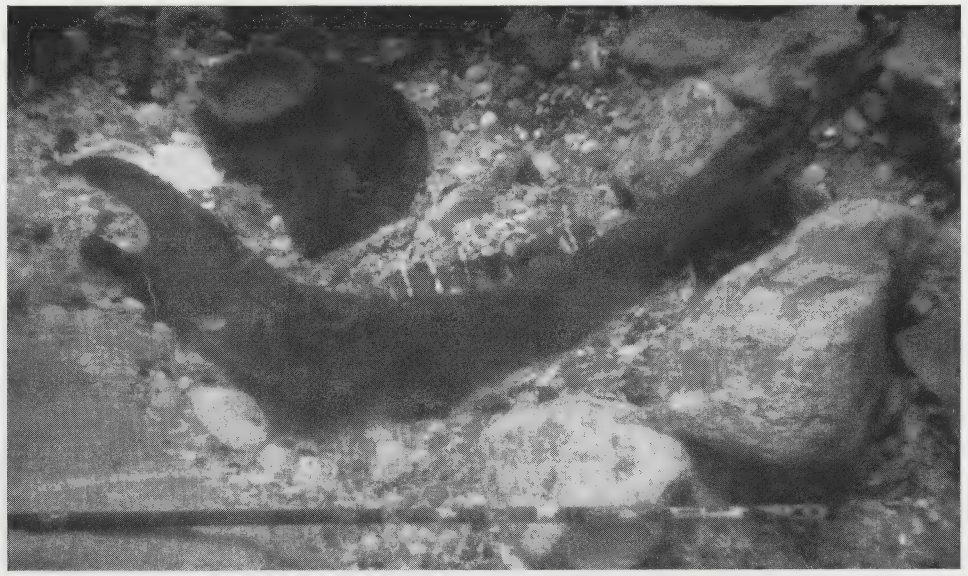


Fig. 17. – The mandible of an ox, as found beside a small black glazed bowl (O 19 on fig. 73).

The last assessment of the bones, Table I (for which we are indebted to Dr. François Poplin, Laboratoire d'Anatomie Comparée, Muséum National d'Histoire Naturelle) shows; ox, sheep/goat, fallow deer, pig and horse to have been carried on board. Some bones were butcher cut, the vertebra of a sheep/goat having been sectioned (as from a carcase cut in half lengthwise), while a pork chop had been trimmed for cooking. Probably all the meat had been butchered, but not every bone in a carcass would show the marks of a chopper.

It will be remembered that the crew's crockery consisted of small, single-portion pots and plates; there were no large cooking pots as on other wrecks. Their absence coupled with the fire-wood on the site, suggests that meat was probably grilled, while the heads of an ox (mandible) fig. 17 and a pig (fragment of *maxilla*) might have been smoked or salted, or otherwise pre-cooked. Livy recounts (29.49.8) that when in 218 BC, the Roman ships by then in Lilybaeum were put on alert, they were ordered to take onboard *cooked* rations sufficient for 10 days. Finally, though there was a notable absence of fishing tackle on board the Punic Ship, at least one *daurade* may have reached its kitchen. This fish makes good eating; its jaw bone was found in a sealed area, so that it could not have post-dated the wreck.

Dr. Poplin comments that the ox, sheep/goat and horse bones were all from small, though adult, animals. The same applies to the fallow deer (whose metatarsal bone was only 240 mm, by comparison with another of 350 mm, which Dr. Ryder examined at Motya).

TABLE I.

Punic ship bones		Provenance
	MAN	
SI/307/72	Neural spine of vertebra	6.9.72 Final bagging K trench
SI/318/74	Shaft of left radius	13.9.74 G13 Tr. S. Stbd. ballast
SI/244/74	Right hand radius? or part of herbivore's rib?	22.8.74 Stbd. ballast
SI/318 a/74	Fragment of fibula	13.9.74 Tr. S. Stbd. ballast
SI/21/73	Fragment of femur?	Sub. P, base Stbd. ballast F1573
SI/4/73	Femur? big splinter very corroded	1.8.73 Top Port ballast
	BIRD	
SI/301/72	"Needle" (for sewing nets) made from ulna of a large bird which could, among others, be a white stork	14.8.72 G6
SI/102/74	Scapula of a bird	5.8.74 W. Stbd. ballast
	DOG	
SI/305/72	Dog's right ulna	14.8.72 Near G6
SI/101/74	Rib of small animal such as dog	Centre ribs by short plank
	HORSE	
SI/324/74	Right metacarpal bone	15.9.74 Trench S. Piton to '72 sandbags F.14.74
SI/304/72	Right lower premolar of adult horse (rather than donkey)	14–29.8.72 i.e. G6 or ribs O–P
	OX	
SI/285/74	Left mandibular ramus, fairly small ox	28.8.74 G8, F11, K trench mid Stbd. ballast
SI/112 a/74	Proximal extremity of a left rib (probably the fifth)	
SI/286/72	Left humerus, adult but fairly small ox	29.9 G9 (lamp) F12
SI/128/73	Left proximal end of radius	N. Piton, Port ,73
SI/285 a/74	Left lower molar of a fairly small ox	
	SHEEP/GOAT	
SI/303/72	Half a lumbar vertebra cut through its length as on a butchered carcass	Ribs O–P 72
SI/124/74	Fragment of a long-bone; tibia?	15.8.74 N. slope Port ballast
SI/331/74	Right calcaneum; probably sheep	14.9.74 Trench G13–S. Piton
SI/331 a/74	Left astragalus; sheep	14.9.74 Trench G13–S. Piton
	FALLOW DEER	
SI/31/73	Left metatarsal	14.9.73 Under Port planking
SI/320/74	Left metatarsal	18.9.74 Landward trench Port ballast
	PIG	
SI/74 (Dunnage)	Fragment of proximal rib; it bears a knife-cut on the concave face and as also been severed across its extremity by two cuts of a knife or chopper	Lifted in bag with sample of organic matter
SI/9/73	Fragment from right maxillary region with the roots of the molar M^2 and the alveolus of the molar M^3	9.8.73 Top Stbd. ballast

Continued TABLE I.

	Faunal remains	Provenance
	FISH	
SI/26/73	Jaw of a *Daurade*	Under Port planking
SI/ /74	Vertebra of selacien of the ray group (*Trygon* rather than *Mylobatis*)	
	, CETACEA	
SI/14/73	Tooth of a cetacean	
SI/302/74	Tooth of a cetacean	
SI/112-/74	Fragment probably from rib	
	TURTLE	
SI/306/72	Fragment from breast plate of shell	
SI/28/73	Fragment from breast plate of shell	

During the first seasons on the Punic wreck, Dr. M. L. Ryder identified the bones, comparing them with others from the nearby, though earlier, Phoenician settlement on the Island of Motya (4).

He estimates from the body-weight of the bones found at Motya that the meat contribution would have been primarily ox, secondly sheep/goat and thirdly pig. This accords with the evidence from the Punic Ship. His further observation that the greater meat contribution supplied by cattle was in keeping with the nature of an urban site, would also apply to stores taken on board a ship. The difference between the diet on board and the diet at Motya may be that more venison was eaten on the Punic Ship (the percentage of fallow deer bones at Motya being small).

Phoenicio-Punic agriculture was unlikely to have changed during the periods in question: up to the fall of Motya, and then until after the fall of Lilybaeum. Certainly animals found on the wreck: a goat, a fallow deer and a dog, are also represented on a mosaic on the post-siege, Roman level at Lilybaeum. Possibly the amount of meat given to Punic sailors exceeded the average townsman's consumption; otherwise the archaeological findings coincide.

The historical background also accords, since the agricultural and stock-breeding skills of the Phoenicians flourished anew in the fertile colonial territory around Carthage. Hand books on husbandry by such experts at Hamilco and Mago, survive through the citations used in translation by later Roman authors. Columella writing in the 1st century AD, remarks: " *While Punic writers from North Africa handed down (their precepts) inla rge numbers, yet many of them are assailed as erroneous by our farmers* " (Columella 1, 1, 6). Despite this reservation, Columella himself made some 40 references to Mago including the famous description of the Punic ox (VI, 1, 3) (fig. 18 -*a*-*b*).

With regard to stock raising in the hinterland of Carthage, perhaps the most telling reference come from Polybius (XII, 3, 3-4) "*for the number of horses, oxen, sheep and goats in the country is so large that I doubt if so many could be found in the rest of the world,*

(4) M. L. RYDER, *Some Phoenician Animal Remains from Sicily*, in *Proceedings of the Archeozoological Conference, Groningen*, April 1974, North Holland Publishing Co., 1975, ch. 3,5.

Fig. 18. – *a*) Mandible of an ox (SI/285/74); *b*) Left humerus of an adult, but small, ox (SI/286/72).

because many of the African tribes make no use of cereals, but live on the flesh of their cattle and among their cattle". It may therefore be that, though comparisons from other ship excavations are somewhat deficient, the picture that emerges of a copious meat diet on board the Punic warship, in contrast with a mainly fish diet on ancient merchantmen, is not so far from the truth.

Bones (Human, Dog, Bird and Funal)

Human

The remaining bones on Table I must be commented, before passing on to vegetable remains and reverting to diet. At least one man went down with the ship. Six fragmentary bones were found, of which 3 are certainly human and 3 possibly human. They represent two arms, two legs and a dorsal bone. Three of the bones; the vertebra, radius and possible fragment of a femur were from sealed contexts and all were from the stern of the ship. The long bones being fragmentary, it is impossible to match them, hence to be sure whether they all belonged to the same individual. But taking into account the manner in which the ship sank, the angle of the keel and the fact that all the fragments of human bone came from the stern, it seems likely that one man had been trapped under the fall of the contents while the ship was sinking.

Dog?

Two bones of a small animal such as a dog were found, a right ulna being in a sealed, central position on the wreck. The dog Anubis is represented on Punic amulets, while a

long legged dog appears on the reverse of a 5th century B.C. coin, a zecca, at Erice. Bones of small animals were also found in the *Tophet* at Motya which, when they have been published may throw further light on this " ships' mascot ".

Bird

The ulna of a large bird, such as a white stork or even a pelican had been fashioned into a needle for sewing nets (fig. 19 *a–b*).

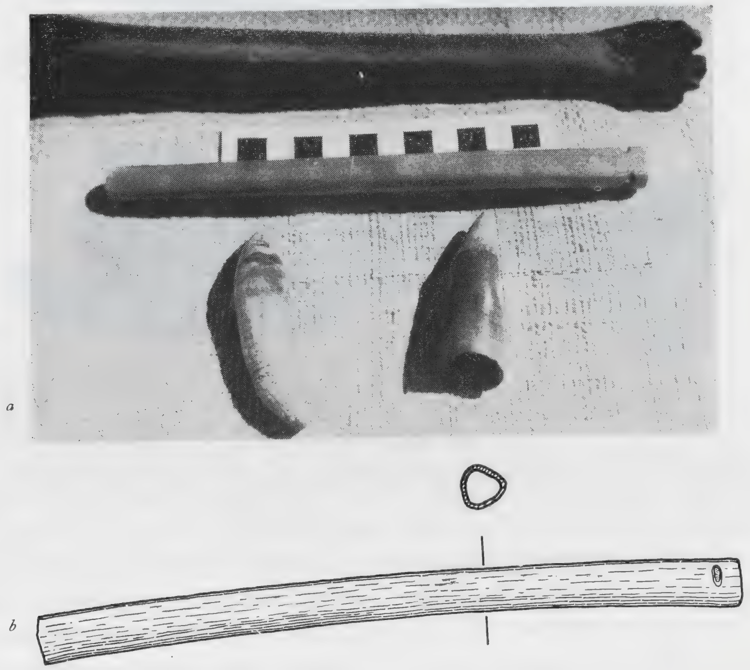


Fig. 19. – *a*) Left metatarsal bone of a fallow deer with a needle made; from the ulna of a large bird and in the foreground the teeth of a cetaceane; *b*) the bird-bone needle (1 : 2).

Faunal Remains

In addition to the teeth and bone fragments of a kind of whale which were examined by Dr. Poplin, three ribs were also found on the site in such a way as to suggest that the wreck-formation was reaching stability at about the same time as the disintegrating carcass of the animal reached it. Indeed the survival of the faunal remains so near to the shore is probably due to the shelter afforded by the wreck-formation. Had it not been for this unnatural obstruction, these large bones would have been carried onto the shore then pounded and eventually pulverised by the waves. Within this area north of Isola Lunga, similar whale bones were excavated from time to time by the sand-dredger well below the present sand level and also in association with ancient wreck formations.

Vegetable Remains

In considering the vegetable part of the Punic sailor's diet, we should keep in mind how the remains were found in the anaerobic environment of this wreck. The keel cavity was packed—over a length of at least 6 m and to a height ranging from 40–90 cm.—with

a brownish " gunge " of compacted vegetable matter. The " kitchen " area, some 8 sq. m, beneath the central break in the keel, contained looser vegetable matter held in sand. The dunnage that was still *in situ* was more thinly distributed between the port-side ribs, while the dunnage and kitchen logs that had spilled when the ship broke had been dragged under the keel (the significance of the distribution of vegetable matter is discussed under " dunnage ").

This vast amount of well preserved, but exceedingly delicate material including such things as fragments of nut-shell, twigs and leaves (as well as string and rope) presented a hideous excavation problem. The leaves, though they looked good as new, disintegrated at the slightest touch. How then to extract representative samples without unduly delaying the excavation of the ship itself? (fig. 20 *a–c*).

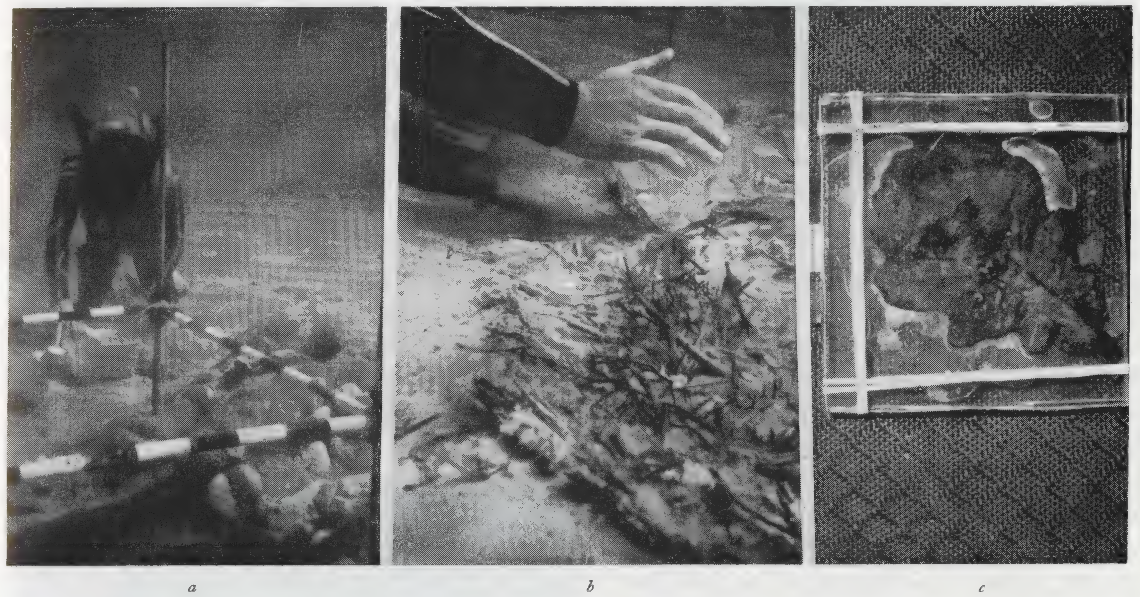


Fig. 20. – *a*) Peter Ball boxes samples of plants from the keel-cavity; *b*) a mass of twigs from the dunnage are excavated by hand; *c*) an oak leaf raised between two sheets of perspex.

At the outset, when the extremity of the stern was being excavated, we carefully picked plant remains from the surface layers of the keel cavity, sealing them into plastic boxes and jars fig. 20 *a*. As the excavation deepened, our supplies of containers became exhausted; we then put lumps of the fill into plastic bags in the hope that they could, eventually, be sorted by botanists working in laboratory conditions. It was, incidentally, in this keel-cavity " gunge " that we first saw distinctive yellowish stems, never more than 2 or 3 cm long, that were later also discovered in baskets and were finally identified as being similar to *Cannabis sativa* (fig. 26).

The problems posed by this quantity of organic matter turned out to be no less acute on land: what to do with boxes and bags of samples too numerous to transport in my van and which, even when reduced, would have kept laboratories busy for years. Indeed, would any specialist be willing to examine the material? We are therefore deeply grateful to Dr. D. Cutler and Mr. F. Richardson of the Jodrell Laboratory at Kew for sifting through so many of the samples (others remained in Sicily, while still more disappeared into various Laboratories and have not been heard of since).

After the first year of excavation we became more realistic. Ideally, a botanist should have been present, but not only are botanists seldom available for archaeological work,

Fig. 21. - Sample of basket no. 1, note the shell of a hazel nut.

but it was impossible to foresee after the first season when the keel cavity had been emptied, that plant remains would continue to be discovered in quantity. As has been seen we gradually learned how to handle and sort the material ourselves. Some interesting specimens may have perished, but taking into account the volume, the following identifications are probably representative.

Nuts and Olive Stones

The nuts could be identified on sight; thus only one pistachio shell reached Kew (see Table II). Nutshells and olive stones occurred in both the keel-cavity "gunge" and in the "kitchen" area. There was no indication of what kind of receptacle had contained them; two hazel-shells were lifted together with a sample of the first basket of "Cannabis" but whether they had been inside it or beside it was not clear (fig. 21).

Nothing distinguished the ancient hazel, almond and pistachio shells from the modern nuts that appear in Sicilian markets every autumn. Similarly, had the olive stones not been found in sealed contexts on the wreck, they could have been mistaken for the remains of our own meals (because we ate the small, local olives rather than the larger and costlier "Greek" variety) (fig. 22).

Neither apricot nor cherry stones were found, though branches of these or similar fruit-trees were present on the wreck. They were examined on the spot by Dr. L. Nocitra and members of the Marsala Agricultural College who visited the expedition in 1971 in order to see the newly raised plant remains. They also singled out twigs of both the wild and the cultivated olive.

Similarly, in 1974, Prof. F. G. Crescimano, (Director of the *Istituto Coltivazioni Arboree*, Palermo University) and his staff examined wood samples as they were being transferred to the first treatment tanks, and again later in that year, some that had just been taken from the sea. They confirmed the presence of fruit-trees and considered that, of three kitchen logs that still had their bark on them, two (SI/B2 and B4A/72) were almond, and the third (SI/B4/72) probably sweet chestnut.

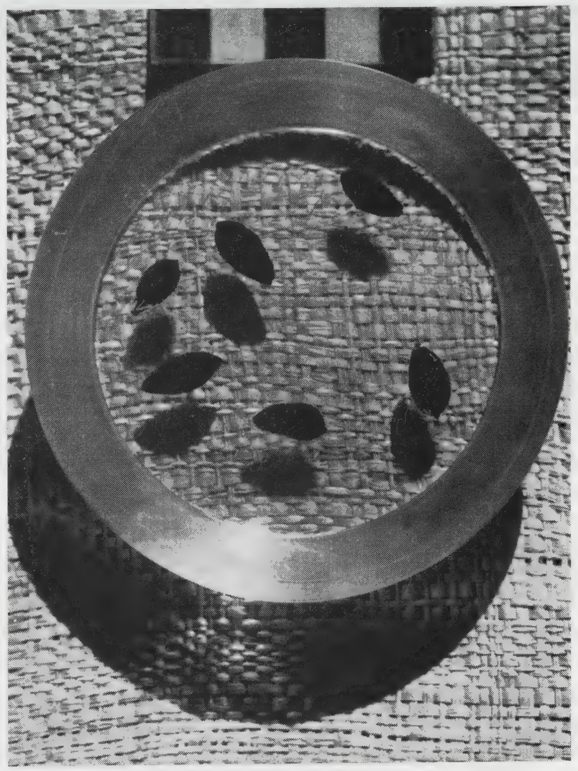


Fig. 22. - Olive stones in plastic.

If these visual identifications are accepted, the presence of nut shells and the absence of fruit stones is significant, suggesting as it does that the ship probably sank during the autumn or winter months.

Punic Plants: History

Sabatino Moscati points out (5) that though date palms are frequently depicted on Punic stelae and coins, the best fruit must have come from the hinterland rather than the coast; certainly no remains of either this tree or its fruit were found on the wreck. He also notes that Mago had advised on the planting and improvement of almond trees, (adding that walnut and pear were likely to have been cultivated as well, though their diffusion would have been smaller). These observations are borne out by the findings on the Punic Ship.

Wine carried in Resin Lined Amphorae

That wine was drunk on board is attested by the vast majority of the amphorae which had the resinous lining associated with the carrying of wine rather than any other liquid. Five samples of this lining submitted to Dr. Oddy at the British Museum Research Laboratory:

" ... were examined by paper chromatography. Some of each sample was dissolved in chloroform and then spots applied to filter paper. Separate spots were diluted with chloroform and methanol respectively, and the chromatograms examined by ultra violet light. This technique enables the samples to be compared with chromatograms of known substances, but does not enable an identification to be made unless a standard sample is available".

The following examples from the Punic Ship:

"SI/5, 7, 126, 127 and 129/71, all gave chromatograms which fluoresced in a very similar manner to those given by samples of an amphora lining from the Ist century BC "Chrétienne A" wreck in France, and a large lump of what appeared to be the same raw material (unmelted) from the Ist century AD Mortar Wreck at Mellieha Bay, Malta (6). These last two had been identified at the laboratory of the Government Chemist as "rosin"; the above 5 samples from the Punic Wreck can thus be fairly safely described as 'resin of a vegetable origin', but it would be unwise to specify rosin on the basis of the chromatograph tests alone".

In type, 4 of these resin or rosin lined amphoras were Graeco-Italic, but the 5th, SI/127/71, was the Punic "cigar-shaped" variety.

It is worth recording these findings against the time when more comparative material will be available on resins and rosins. The lay reader may be interested to know that such amphorae linings still bubble when set alight and give off the characteristic smell of the resins (see too "woven fabric impregnated with resin", p. 263).

(5) S. Moscati, *The World of the Phoenicians*, Cardinal, London 1973, p. 222.

(6) For both see H. Frost, *The Mortar Wreck in Mellieha Bay*, London (for the National Museum, Malta) 1969.

Cannabis?

Finally, it is possible that the Punic sailors drank an infusion of *Cannabis*. Before discussing the evidence, the hemp plant itself may need some introduction. It grows in most places, its properties varying in accordance with the climates; where there is most sunshine, the drug content is strongest. The difference between the *Cannabis sativa* (the

Fig. 23. - Basket no. 1 as first seen in 1973; the circular object is a diving weight 8 cm. in diameter used as a scale. *Photo J. Blair, National Geograpic Society, U.S.A.*

Mediterranean variety) and the *Cannabis indica* for instance, amounts to no more than trace elements from the different soils. The drug content also varies within any one plant according to the part from which it has been extracted: the strongest " pot " is made from the pollen and upper leaves; the milder middle leaves could make cigarettes ("kef"). The drug does not however, have to be inhaled: the lower leaves of the plant would make a mildly intoxicant salad and the dried stalks, if infused, a mildly intoxicant tea. When swallowed, the effect of the drug is slower but more long lasting; some of its medicinal uses are discussed below.

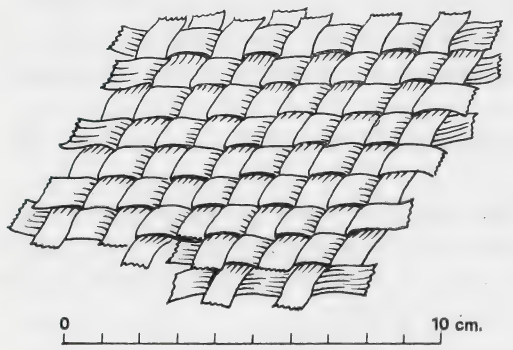
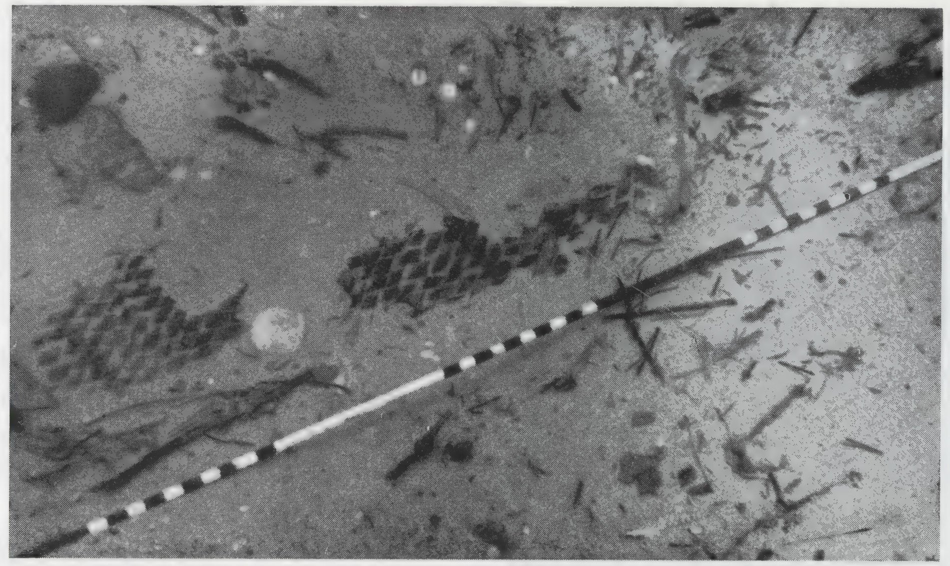


Fig. 23 *a*. - (SI/34/73) Fabric of basket no. 1, woven from the leaves, approximately 8 mm., wide, of a sedge-like plant. *Drawing by James Wolfe-Murray* (1 : 2).

On the Punic wreck, the distinctive, yellowish stems of a plant were always found in association with food, but never amongst the dunnage between the ribs of the hull. They were first noticed in 1971, together with the olive stones, nutshells and fragments of the miniature "egg-shell" ware pots in the dark "gunge" that packed the keel-cavity. The stems, though few, stood out because of their light colour. This surprised us because, had



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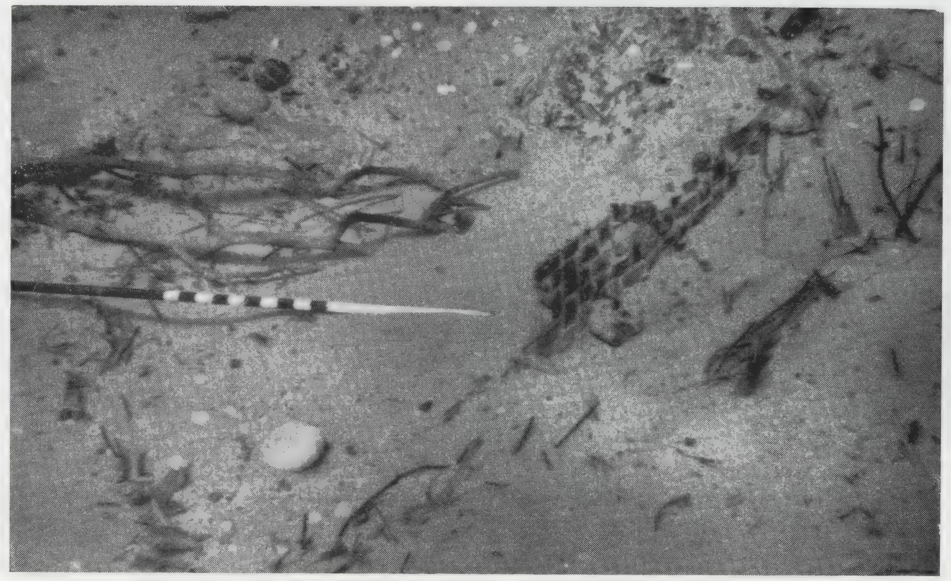


b

Fig. 24 *a–b*. - *a*) Two views of further remains of basket no. 1 found in 1974. Note the twig on *b*) which were later conserved, see fig. 25.

they come from an herbaceous plant they would originally have been green, so that like the rest of the plant material in the anaerobic conditions of this wreck, they should have turned darker rather than lighter with age unless, of course, they had been dried and so bleached, before being taken on board.

Initially we had ' bagged ' all the organic matter with unselective piety. Consequently, if any of these stems did reach Kew in 1971, they must have been overlooked among the welter of other material. By 1972, hardly any "gunge" was left at the shallower end of the keel-cavity, so we forgot about the yellow stems, but at the end of the 1973 season, a basket full of them was discovered in the "kitchen" area. A sample was raised and studied on land (fig. 23 and plan fig. 73 at N–O, 28–29).

To our untrained eyes the stems looked like pieces of a small bamboo (a supposition that would also have explained their light colour). This time, specimens of both the stems and the basket fabric were put into glass tubes and sent direct to Kew, with the following results:

Fig. 25. – The twigs beside basket no. 1 (fig. 24 *b*) after conservation by freeze drying.

« *SI/34a–c/73. Three Tubes: the Contents of a Mat or Basket*

The tubes contain the remaining woody cylinders of stems of an herbaceous plant, a Dicotyledon, not a bamboo-like grass. The structure is of a kind common to many of the tall rather woody herbaceous plants and in many aspects similar to the woody stems of the hemp plant *Cannabis sativa L.*":

SI/34f/73, Fabric of Mat or Basket

A Monocotyledon, probably all leaf material, no culms or stems seen, only culticular epidermal remains: stomata or abaxial surface only, silica bodies not seen ? a sedge-like plant. » (Feb. 19, 1974, from Dr. D. F. Culter, Jodrell Laboratory, Kew; identification by Mr. F. Richardson).

The other plants of similar structure to hemp are: nettles (a widespread family) and hops. In either case, it is improbable that their stalks would have been cut up, put in a basket and taken on board a warship. Hemp is of course, also used for making rope, but exceptionally, all the rope and string on this wreck was made from esparto grass. In any case, a basket of hemp stems would have been useless for rope-making.

There, tantalisingly, the matter might have rested, the basket having been discovered during the last days of the catastrophic 1973 season, when the lifting of the exposed hull had to take precedence over any plant remains, however intriguing. But in 1974, to our astonishment almost the first thing to be uncovered was the rest of the same basket; crumpled and folded, it had been buried in an upright position, surrounded by masses of twigs and string (fig. 24 again at N–O 28–29 on plan fig. 73).

Had it come to rest on its side, it would have been easier to excavate. Despite its fragility, a large area of its surface could have been exposed; as it was, only small portions of the basket and its fill could be photographed at any one time. It was apparent that the basket had had plaited handles (see rope and string p. 94), which together with the way the leaves of the " sedge-like plant " had been woven, made it identical to a type of basket known locally as the "*koffa Tunisina*" that is still imported to Marsala from North Africa (fig. 23 *a*).

The basket having been re-discovered at the beginning of the season, we were able to collect larger quantities of the contents for submission to Kew so that Mr. Richardson could select the best preserved for examination:

«*SI/II/74. Portions of the woody cylinders of an herbaceous Plant found in a Basket*".

The structure of this material is the same as that of the previous samples which showed wood characters similar to members of the Cannabinaceae and related families. In the bark fragments there was no evidence of hairs with bulbous bases containing cystoliths, or the typical bast fibres which would confirm that these stems are cf. *Cannabis.* » (Jan. 28, 1975, from Dr. M. Y. Stant, Jodrell Laboratory, Kew) (fig. 26).

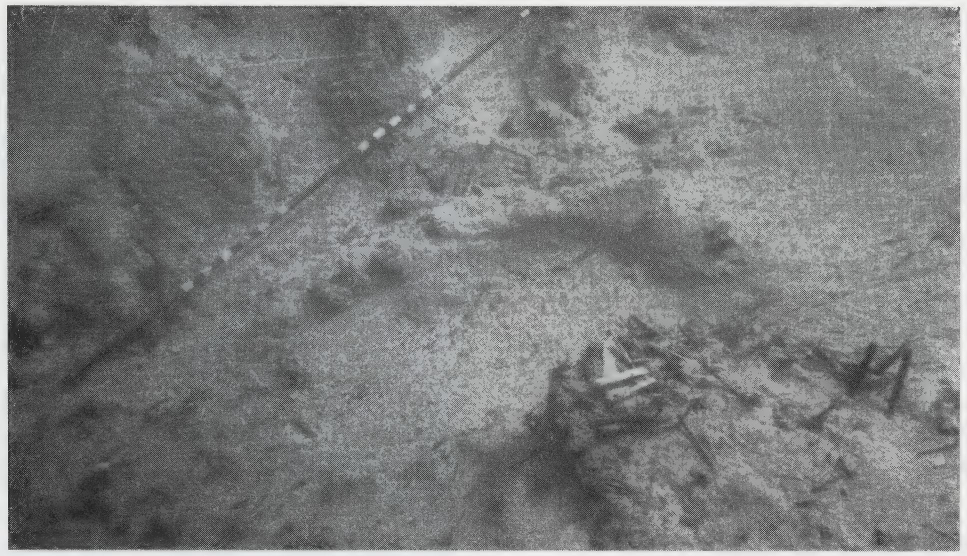
Fig. 26. – Stems of *Cannabis* embedded in plastic.

In other words, the minute hairs that might have clinched the matter one way or another, had decayed; which even in the anaerobic conditions on this wreck is not surprising after two millennia! Doubt remains, but also the question; if these stems were not *Cannabis*, what were they? A question that could not be dismissed because on the last day of the excavation a second basket was discovered only a few metres or so from the first: it is probably still on the seabed (fig. 27 and M 27 on plan fig. 73).

There had not been time enough to clear all the organic matter from the " kitchen " area beneath the break in the keel. We had trenched round and across it, down to the virgin bottom, to make sure that no hull was buried beneath it. But this area was very near the shore, so that in the autumn weather, even trenches well over a metre deep would fill overnight with *Poseidonia* leaves mixed with sand. Peter Ball spent his last afternoon on the wreck dredging a trench by the second basket. The following day, despite bad weather, I returned hoping to be able to take more photographs and samples, but found the bottom flat again, under a gently swirling mass of " sea-grass ".

History and Anthropology

In ancient Mediterranean cultures, many religious frenzies, miraculous happenings and oracular practices as well as some obscure " cult objects " could have originated in a priestly dispensation of drugs. Unfortunately the mechanics of such events have, with one exception, remained a well kept secret. Herodotus writing in the 5th century B. C., describes how *Cannabis* was used in Scythia during the purification ritual after burials such as he himself had witnessed. A felt tent was erected; inside it *Cannabis* seeds were thrown onto



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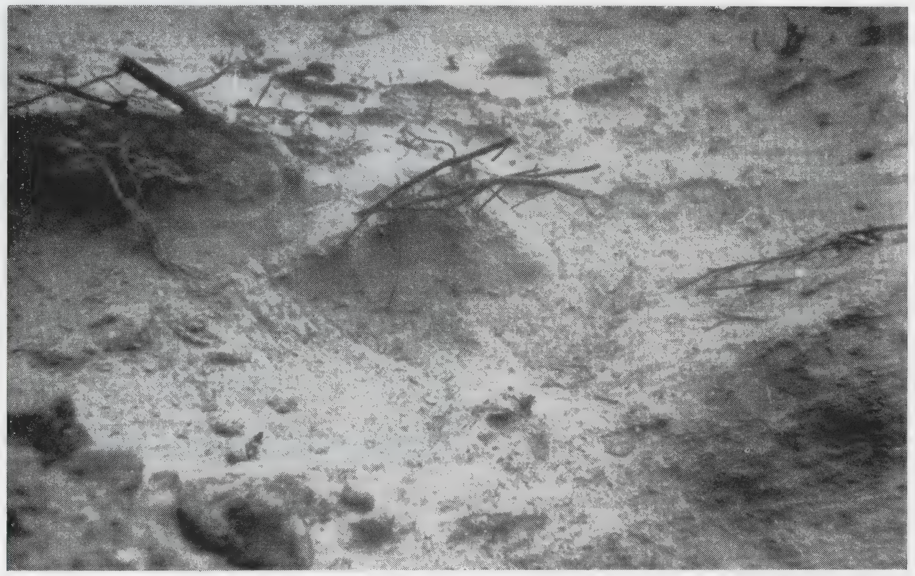


b

Fig. 27 *a–b*). – Basket no. 2 photographed on the last day of the excavation. In *a*) parts of its fabric show above the measuring rod; in *b*) it can be seen at the top of the picture and again in the lower right hand corner.

hot stones and the fumes inhaled: "*immediately it smokes, and gives out such a vapour as no Greek vapour-bath can exceed; the Scyths, delighted, shout for joy*"—the equivalent, one presumes, of our northern wakes (7).

These words were confirmed in the nineteen fifties when Rudenko excavated the deep-frozen Scythian burial-mounds. Rudenko goes further than Herodotus: "*the smoking of hemp, like smoking hashish, took place without a doubt not just as a ceremony of purification after burial, but in ordinary life. Not without reason Hesychius of Alexandria in his*

(7) Herodotus, *History*, IV, 75.

Lexicon, referring to what Herodotus calls hemp as 'the Scythian smoking' ...Both men and women probably smoked, since we found two sets of apparatus for smoking with the burial of a man and a woman" (8).

Corroboration of what must have been the widespread use of another common drug, the opium poppy, among the remote Phoenician ancesters of the Carthaginians, was recently discovered by Dr. Vassos Karageorghis at Kition in Cyprus. A juglet containing opium, also part of the apparatus possibly used for smoking it, was among the offerings in a small Bronze Age Temple dedicated to a fertility cult. Another of the offerings was a figurine of Bes, the protector of women in childbirth —whose help may have involved opiates (9).

The remains of opium in similar, 15th–16th century B. C. juglets found in Egypt, imply that it had been a Cypriot export, while R. S. Merillees suggests that the shape of the containers themselves is modelled on the opium poppy capsule (10).

Thus, drugs being known in the ancient Near East, it is logical to suppose that they had many uses. Archaeology offers no hint of their purpose on board an oared ship, but anthopology provides one explanation. In the modern Levant, it is common knowledge that workmen take hashish. Long distance lorry drivers, for instance, smoke it to relieve the fatigue of the excessive hours they have to work. In homeopathy, the application of small doses of *cannabis* is very varied, but one of the effects is to relieve fatigue (11). Otherwise, most clinical enquiries into *cannabis* are irrelevant because the subjects either smoke for "kicks", or in the cause of science, recent study was carried out in natural conditions: in Jamaica in 1972, by the Institute for the Study of Man (New York) and allied bodies (12). *Cannabis* known by its Hindi name: *ganja*, is widely used among Jamaican workmen such as farmers, fishermen, masons and carpenters, whose ancient ancestors introduced the drug from East India, whence they came as indentured labourers on the sugar plantations. The Report notes: "*almost without exception users maintain that* ganja *enhances their ability to work, that is to perform manual labour, and they regularly consume* ganja *with this objective*". The case history of a man sawing wood, for instance, showed that after taking *cannabis* his mind gradually focussed first, on the act of sawing wood and then on the saw itself to the exclusion of all else.

On a ship propelled by oarsmen this effect would be invaluable; it justifies the suggestion that the two baskets of dried stems in the Punic Ship's kitchen were indeed *cannabis*, but whether they would make an infusion potent enough to give fighting men "Dutch courage" is less certain. The drink would probably make a poor substitute for the "tot of rum" which, until recently, was issued in the British Navy.

Honor Frost

(8) S. I. Rudenko, *Frozen Tombs of Siberia*, Dent, London, 1970, p. 62.
(9) V. Karageorghis, (personally communicated, 1975).
(10) R. S. Merillees, in *Opuscula Atheniensia* 8, Lund 1968, p. 3.
(11) W. Boericke, *Homeopathic Materia Medica*, New York, 1927, p. 162
(12) G. Haber, *Marijuana at Work*, in *The Sciences* 15, New York Academy of Sciences, 1975, pp. 18–20.

VI. THE SHIPBUILDING TIMBER

The identifications of the various woods used to build the hull of the Punic Ship have a twofold significance. Firstly, if a ship is considered as an artifact then the woods in it have a structural meaning that will increase as further comparisons become available, each newly excavated a ship contributing to the explanation of its predecessors. Secondly, though the woods can give no direct clue to the place where a ship had been built (because more often than not they would have been imported to the shipyard), they can throw light on the timber trade of the period in the same way that the food-remains on a ship have a bearing on the agriculture of the period.

In Mediterranean archaeology it is apparent that trade in timber was established by as early as the 3rd millennium B. C. This is particularly clear from Egyptian findings: the " Cheops ship " for instance, must have been built from imported wood (1). Moreover, in the case of ships (unlike isolated wooden objects found on land excavations) it is feasible to relate their woods to a general pattern of trade; I therefore postulate an historical parallel for the sources of the woods used in the Punic ship.

Table I, pp. 70–71, shows the identifications by the Plant Anatomy Section of the Royal Botanic Gardens, Kew, of the woods in the Punic and Sister Ships together with some detached timbers possibly from these wrecks, or from others in the same area. These identifications are grouped so as to show the woods used:

a) below the waterline (this being the part of a ship for which archaeological comparisons are usually found);

b) in the superstructure (for which excavated comparisons are few, but which are likely to be mentioned in ancient texts).

Comparisons: below the Waterline

Below the waterline, the planking of the Punic Ship was made of pine, the tenons and dowels of oak and the ribs of both oak and maple. The after part of the keel was maple and the central portion pine. Similarly, the Sister Ship had pinewood planking and oaken ribs, but the dowel sample proved to be olive wood, while the ram was made of a different kind of pine from the planking. No sample was taken from the Sister Ship's keel, but visually it was yellow and evidently a softwood like pine.

This combination of a softwood for planking and at least the central part of the keel, and hardwoods for the skeletal parts, tenons and dowels appears to be usual in merchantmen of the classical period, but this is no more than a general impression based on excavators' observations of wrecks found undersea. Published comparisons are few and they

(1) B. Landström, *Ships of the Pharaos*, London 1970, p. 28.

TABLE II.

SITE NO.	DESCRIPTION	PROVENANCE SITE	IDENTIFICATION	LAB. DATE
	"PUNIC SHIP", THE HULL.			
SI/K1/71	Rise of Keel; stern post	Stern	*Acer* species	13.1.72
SI/K3/73	Central portion of Keel	Keel	Pine of the *Sylvestris* group ("Scots pine"—"yellow deal") which includes:— *Pinus nigra* Arn. ("Corsican pine") Arn. var. Calabrica (Loud) Schneid and the "Austrian pine".	
SI/63/71 SI/65–6/71	Planking	Hull	All 3 samples of pine from a species of the *Pinus* group which includes *Pinus nigra* and *Pinus sylvestris*	13.1.72
FT/30/71	Floor-timber	Ribs (see plan)	*Acer* sp.	
F/27/71	Frame		*Quercus* sp.	
F/7/72	Frame		*Quercus* of the *Q. robur* (northern) type	6.4.73
FT/8/72	Floor-timber		*Quercus*	
FT/10/72	Floor-timber		*Quercus*	
F/11/72	Frame		*Quercus*	
F/13/72	Frame		*Quercus*	
SI/B2/72	Tenon	representative	*Quercus* sp.	
SI/B2/72	Dowel	representative	*Quercus* sp.	
	SUPERSTRUCTURE SHAVINGS AND CHIPPINGS			
1	Samples selected from box of organic matter taken from the Keel-cavity	stern	a soft wood probably cedar *Cedrus* sp.	13.1.72
2			oak, *Quercus* sp.	
3			beech *Fagus sylvatica* L.	
4			maple, *Acer* sp. could be *A. monspessulanus*	
5			*Pistacia* probably *P. atlantica* could be *P. terebinthus* or *P. lentiscus.*	

Continued TABLE II.

SITE NO.	DESCRIPTION	PROVENANCE SITE	IDENTIFICATION	LAB. DATE
SI/SF81/74	Samples of shavings and chippings from central "Kitchen area"	break in Keel	10 samples taken at random: 6 pieces of fir, a species of *Abies* 2 pieces of oak, *Quercus* of the *cerris* (southern) group 1 piece of maple *Acer* sp. 1 piece of pine *sylvestris* group	28.1.75
SI/T2/74	"shield-holder"	stern area	"walnut", *Juglans* sp.	
	"SISTER SHIP" (SOUNDING)			
SS/PI/74	Plank	representative	pine *Pinus* of the *sylvestris* group	
SS/RI/74	Rib	loose on surface	*Quercus* species of the *cerris* (southern) group	
SS/R2/74	Rib		*Quercus* species of the *cerris* (southern) group	
SS/D/74	Dowel	representative	*Olea europaea* L., olive	
SS/Rm/74	Ram		pine *Pinus* sp. probably of the "Ponderosa" group this includes *Pinus pinaster* Ait. the Maritime pine.	
	THE WALE (PS OR SS)			
TX/17/73	4.79m Timber	found loose on P.S. site to landward, could have washed over from SS.	oak, a species of *Quercus* of the *cerris* type	19.2.74
TX/7/73			olive, *Olea europaea* L.	
TX/7/73			olive, *Olea europaea* L.	

must be treated with caution whenever it is not clearly stated that samples have been identified by a plant anatomist.

As usual, the Grand Congloué and Nemi Ships are the best documented. Benoit gives the Congloué's floor-timbers and dowels as oak, the keel as pine and the planking as Aleppo pine (2). Ucelli cites Cesare Sibilla's identifications of the woods used in the Nemi Ships as:

Conifers: *Pinus halepensis*, *P. laricio*, *Abies* and *Abies pectinata* (i. e. "silver fir", or *Abies alba*);
Dicots: *Quercus sessiflora*, *Q. pedunculata*, *Q. cerris* (3).

He states in the text that some dowels were made of *rovere* (*Q. robur*), otherwise the natural assumption must be that the conifer was used principally for the planking and the oak for the skeletal timbers. He also states that all the woods were available in the Nemi Region, except the *Abies pectinata* which, according to Sibilla had died out, although its fossil remains suggests that it might have been growing there when the ships were being built.

By contrast, skeleton, shell and even the dowels of the small 4th century Kyrenia Ship were all made of pinewood: only the tenons and a " shoe " fixed to its atypical curved keel were oak (4). This exceptional use of softwood thoughout may, in part be explained by the ship's small size (only 10 m. of keel).

Equally unusual, but more easily explained were the woods of the 6 "Fiumicino Boats", that were excavated in the Claudian part of the *Portus* of Rome. The three largest were built entirely of oak, while the three smaller had larch-wood planking over oak timbers (5). The use of oak for planking is strange, because as Theophrastus remarked: "oak rots in seawater" (6); these boats may, however, have been used as much on the Tiber as at sea. Certainly they reflect a local type of construction.

Yet another combination of woods is recorded in the account of the 2nd century merchantmen recently excavated in the Place de la Bourse, Marseilles: the planking was of larch, the ribs and tenons of oak and the keel partly of Cypress and partly of pine " *epicea* " (7).

Such heterogeneous comparisons have the merit of being botanical statements, but they are not representative. It is to be hoped that further reliable identifications will soon become available from other wrecks. Meanwhile, it still seems likely that the general impression is correct and that the bottoms of most classical hulls had softwood planking over a hardwood skeleton. The rare and consequently more interesting and diagnostic woods were probably used in the superstructure.

Woods used in the Superstructure

Although only two fragments of the Punic Ship's superstructure survived, many samples of the woods used therein were preserved in the form of carpenters' shavings and chippings that had fallen into the bottom of the hull while the men were still working aloft (for

(2) F. Benoit, *op. cit.*, pp. 152, 150, 149 and 151 respectively.
(3) G. Ucelli, *op. cit.*, p. 134.
(4) M. L. Katzev, in *Illustrated London News*, June 1974, pp. 69-72.
(5) O. Testaguzza, *Portus*, p. 129 ff., Rome 1970.
(6) Theophrastus, *Hist. Plant.*, 5, 43.
(7) J. Contrucci, *Quand Marseille dialogue avec Massilia*, in *Le Monde*, Dec. 16, 1975, p. 25.

reasons discussed in the next chapter). Thanks to these chippings, the following list of superstructure woods must be among the longest to emerge from any wreck excavation:

Beech (*Fagus sylvatica*); oak of the *cerris*, or southern variety (as distinct from the *Q. robur* in the infrastructure); pistachio; fir; walnut and probably cedar, besides the maple and pine that had also been present below the waterline.

Beech is the most significant of these woods, since its distribution in Europe has a well-defined limit (fig. 28). The tree does not grow in North Africa. Its most likely sources in this instance would have been Italy, Corsica or Northern Spain. The north eastern mountains of Sicily itself are less likely because at the period, this territory might not have been accessible to the Carthaginians.

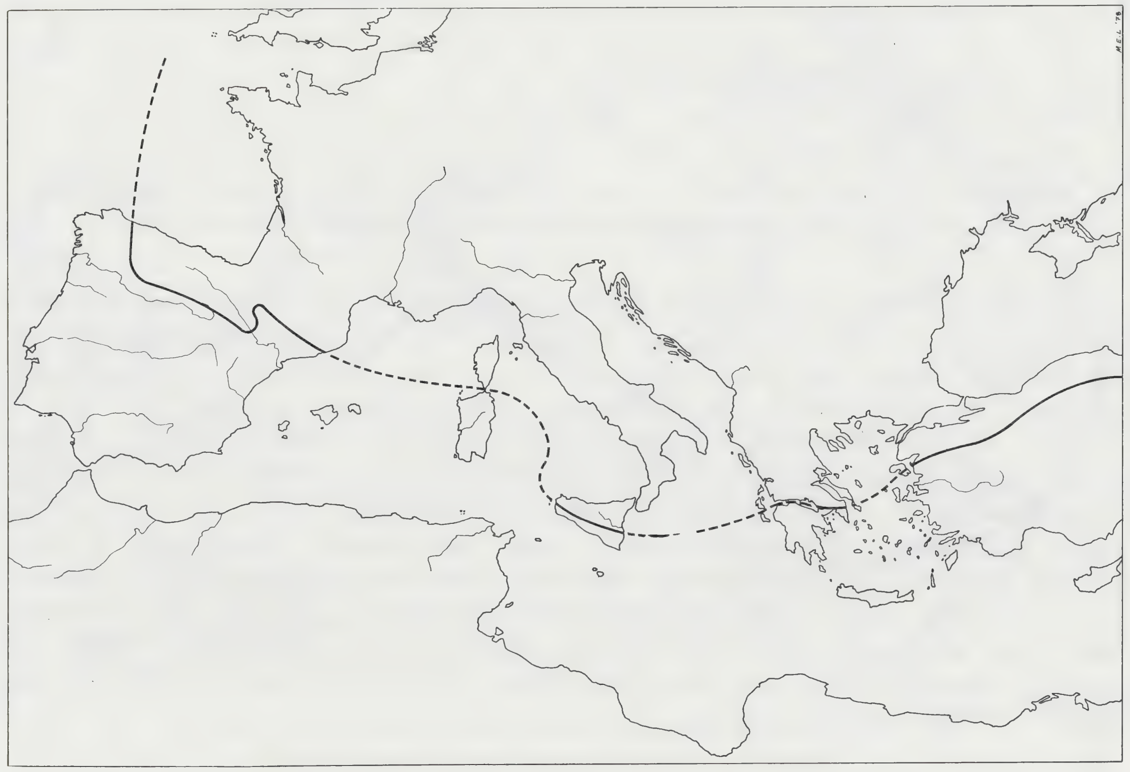


Fig. 28. - The southern limit of the beech tree. *Drawing by Michael L. Leek.*

The sample described as " probably cedar " suggests a North African provenance (fig. 29). Arabic sources imply that cedars may also have been growing on the slopes of Mount Etna during the period in question (see below), but again, Carthaginian shipbuilders were unlikely to have used forests that were in enemy territory. In North Africa, however, cedars grew nearer the sea and not far from Carthage itself in the Djurdjura and Babor Mountains (I am indebted to Dr. J. F. G. Bynon of the School of Oriental and African Studies for pointing this out to me).

One of the woods from the Punic Ship's superstructure, pistachio, has also been found in another Sicilian wreck, the Byzantine Ship from Pantano Longarini (8). Its excavator

(8) P. and J. Throckmorton, *Pantano Longarini*, in *IJNA* 2, 2, p. 263, London 1973. Throckmorton mentions that *Pistacia* was found (use unspecified) in this Byzantine wreck. By analogy with modern Mediter-

suggests, by analogy with modern Mediterranean shipbuilding, that pistachio indicates an Eastern provenance for his wreck. However this may be, there is no reason to apply the suggestion to the Punic Ship, because the various species of pistachio also grow along the South Western Mediterranean coast and indeed in Sicily itself.

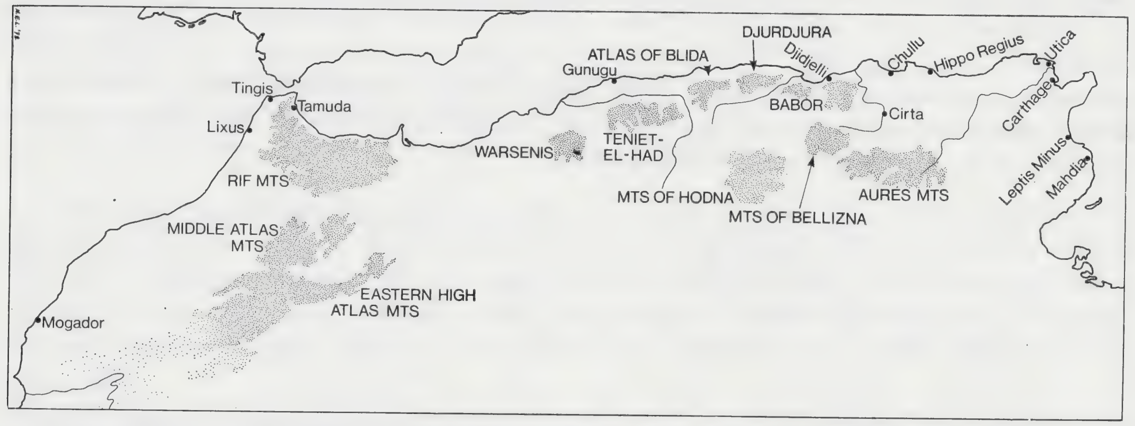


Fig. 29. – The distribution of cedar in North Africa. *Drawing by Michael E. Leek.*

On land, wood from Carthaginian excavations is rare. D. B. Harden notes that there is evidence to show that the Carthaginians inherited the woodworking skills of their Phoenician ancestors, but the surviving artifacts amount to little more than a couple of " cedar or cypress " chests (one from a 3rd century B. C. tomb at Mahdia) (9).

There are no contemporary references to the woods in Carthaginian ships, but their enemies' shipbuilding materials are mentioned by Athenaeus (5, 206–209) in his account of the building of a giant freighter by Hiero II of Syracuse in the 3rd century B. C. Timber " sufficient for 60 quadriremes " came from Mount Etna; wood to make ribs and dowels (i. e. hardwoods) came from both Sicily and mainland Italy; bulkheads were made from both cypress and boxwood, and doors of boxwood and " aromatic cedar " (no provenance stated for the latter, but Etna is a possibility). Earlier, in 397 B. C., Dionysus of Syracuse had taken timber from Etna to build his fleet for war against Carthage (Diodorus, 14, 7).

Sources of Shipbuilding Timber

Although contemporary evidence is scant, later history implies the sources of Punic shipbuilding timber. From the 7th to the 9th centuries Arabic fleets dominated the Western Mediterranean; the coincidence between the sites of Carthaginian ports and the earliest Arabic naval harbours is striking. There is also reason to believe that both nations used the same timber-forests. Had Mediterranean forests remained unchanged, the Arabic evidence would not be worth mentioning in connexion with the Punic Ship, but in fact large parts of this region are now deforested. Consequently, to ask where the trees used in the

ranean shipbuilding, he argues that the wood suggests an eastern Mediterranean provenance for the wreck, but there is no reason to believe that this was so in antiquity since the various species of pistachio also grow in the central Mediterranean and North Africa.

(9) D. B. Harden, *The Phoenicians*, London 1971, p. 132.

Punic Ship grow today would be irrelevant, but it is certain that the forests used by the Arabs must already have been growing when the Carthaginians built their fleets.

Man's depletion of conveniently situated forests began with industry itself, but re-afforestation was not practised until relatively modern times. Strabo gives an early instance of how the exploitation of Spanish mines by the Phoenicians and the Romans destroyed local forests, the trees having been taken to feed furnaces and make pit-props (10). History went on repeating itself: goats and empires (notably the Roman and the Ottoman) are held responsible for the *maquis* that now covers the shores of the Mediterranean, this scrub having sprung up where once there had been forests.

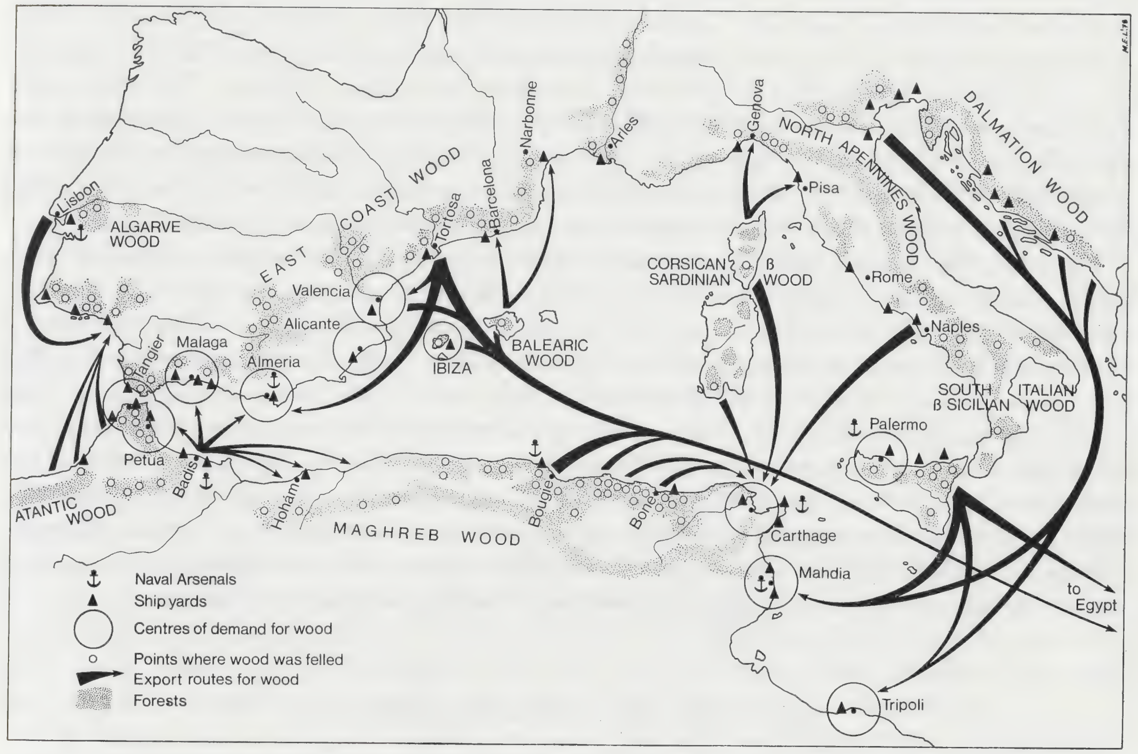


Fig. 30. – The timber of the Moslem period, 7th to 9th centuries A. D.
Drawing by Michael L. Leek after Maurice Lombard.

Arabic texts are explicit as to the sources of timber for building the first Muslim fleets in the West. The naval implications of these texts have been discussed, notably by Maurice Lombard (11) and Ali Mohamed Fahmy (12), and the continuity of the shipbuilding traditions is evident. Initially in the Levant, when the first Arab invaders arrived there, they took over the flourishing technology already established by the Phoenicians, the Greeks and the Romans. Their inheritance is particularly evident in Egypt, especially in the case of shipbuilding. Always a conservative craft, shipbuilding in Egypt was

(10) Strabo II, 3, 10.

(11) M. Lombard, *Arsenaux et bois de marine dans la Méditerranée musulmane* (7–11- *siècles*), in *Le Navire* (2- colloque d'Histoire maritime) S.E.V.P.E.N., Paris 1958, pp. 58–140.

(12) Fahmy, Ali Mohamed, *Muslim Sea Power in the Eastern Mediterranean from the 7th to the 10th Centuries AD*, Don Bosco, Alexandria 1950.

practised by hereditary guilds; the Aphroditi Papyri (which list shipbuilding materials) are, for instance, written in both Greek and Arabic.

The following reference to Carthage itself shows that, on arrival in the West, the Arabs were not unconscious of the past. In 699 AD they founded their first North African arsenal on the site of Carthage and called it Tunis. Like the Carthaginians before them who had built a *cothon*, the first Arabic Governor (reputedly Mûsâ ibn Musyar) also constructed artificial, inland docks. The Kitâb al-Imâma gives details:

"Mûsâ gave orders for the building of an arsenal (dâr sinâ'a) which was to be connected with the sea. The people generally did not approve of his project, but a Berber who was a fervant convert to Islam, approached him saying: 'O Governor, I have lived a hundred and twenty years and I remember my father telling me that, when the Governor of Carthage wished to cut a canal the people protested, but one man advised him to complete the work, because kings were all powerful and could do as they pleased. Therefore carry out your plan O Governor, and God will help you to fulfill your aim and will reward you for your work'. Acting on this good advice Mûsâ built the dockyard and connected it with the sea 12 miles away. He then had 100 warships constructed there and from that time the arsenal provided ships with a refuge from the wind and storms of winter" (13).

Besides the mention of Carthage, this passage is significant for another reason: as soon as the dockyard was completed we are told that as many as 100 ships were built in it. The old Berber probably had good reason for the optimistic advice he gave to Mûsâ: the Berber race comes from the coastal ranges of the Grand and Petit Kabylie whose forests constituted one of the principal sources of ship-timber at that time. Such timber had to come from slopes that were near the shore, because the tall trees needed for masts and keels could not be transported over long distances on the backs of pack animals. Maurice Lombard has shown that timber from the Kabylia travelled by sea not only to the arsenal at Tunis/Carthage, but it was also shipped via Iqlibia/Clipea at the tip of Cape Bon, over to Marsala/Lilybaeum which was the nearest point on Sicily. The other established routes of the Arabic period are shown on fig. 30, which is based on Lombard's findings.

Provenance of Timber and Shipyards

From this probable coincidence of the Punic and Arabic shipbuilding forests, consequently of the sources of the woods used in the Punic Ship, arise two further factors that should be kept in mind when considering the aggregate of the evidence for the region where this ship was built. The first is navigational and the second, which is related, is the traditional siting of shipyards on Mediterranean islands.

Arabic records mention the mountains of Eastern Sicily as a source of timber (14), but they are an unlikely source for the wood on the Punic Ship, not only because the terri-

(13) Fahmy, *op. cit.*, p. 69.

(14) I am grateful to Miss Venetia Porter, as an Arabic scholar and as a member of this expedition, for following the references to tree names in Michele Amari's *Storia dei Musulmani di Sicilia* to their original sources in Yāqūt's *Mu'djam al-buldān* and Qaswīnī's *'Adja'ib al-Makhlūgāt*. Yāqūt and Qaswīnī were, hovewer only quoting abu-Ali Hasn ibn Yahya, the medieval Sicilian chronicler whose work is no longer extant. In any case the first mentioned author's references to *'arzan* (as "cedar") are problematic and as William Johnstone pointed out, it is impossible to marry the evidence of medieval geographers to classifications by modern botanists. Miss Porter's research is best reserved for a more detailed discussion than would be justified in this report.

tory may have been inaccessible to the Carthaginians, but also because Sicily was difficult to circumnavigate (and such evidence as we can muster suggests that the Punic Ship was built in the Western rather than the Eastern Basin of the Mediterranean). Ease of navigation rather than proximity is likely to be the determining factor, it being easier to sail over long distances profiting from prevailing winds, than to face such difficulties as the Straits of Messina. Indeed the export routes which Lombard has given for Eastern Sicilian timber run either eastwards, or south of Mahdia. The routes he gives for the export of Corsican and Balearic timber do, however, converge on Carthage and in this connexion we should note that the Balearic Island of Ibiza takes its name from the Phoenician *Ibuzim* meaning the islands of pine.

Islands as Shipyards

The ancient Mediterranean tradition of building ships on small, tree-less islands is attested from as early as the Bronze Age. A particularly clear example within the Phoenician tradition is the Island of Arwad off the north Syrian coast: though little more than a rock and without any natural resources, it is still densely populated and craft are still built there (of wood imported from Turkey and the Adriatic); until quite recently the Island gave its name to a type of schooner. In antiquity its prosperity is attested by its coinage, while the remains of its colossal, Hellenistic and Bronze Age sea defences present massive archaeological confirmation of the many references to the Island as a centre for shipbuilding in sources ranging from the Bible to the Tell el Amarna Letters.

Similarly, certain Greek islands are known for their specialization in shipbuilding, while in the central Mediterranean there are many comparable centres such as the Island of Gozo (where ships are still built from wood imported from the Adriatic and even from Britain). Nearer the site of the Punic Ship, indeed between Carthage and Lilybaeum, there is reason to suppose that the Island of Pantelleria (Cossura) was another such centre. Again, the importance of its coinage suggests that it had resources beyond its agriculture and, significantly, a coin of Pantelleria minted in 217 B. C. was discovered *in situ* in the mast-step of a wreck known as the "Chretienne A" (15) off the French coast (traditionally, coins were placed in mast-steps by the builders when a ship was nearing completion).

It follows that, having postulated sources of Carthaginian shipbuilding timber and the trade routes, we should not necessarily attempt to deduce the building place of the Punic Ship from among the well known naval bases such as Carthage, or Lilybaeum. Timber following the routes that Lombard has given, could equally well have been unloaded on an offshore island-shipyard within the Carthaginian zone of influence: like Pantelleria, or even some island off the Etruscan coast. Such considerations must now be suspended; they will be resumed once all the excavation evidence has been presented and a final assessment is being reached.

Honor Frost

(15) F. Dumas, *Epaves Antiques*, p. 123, Paris 1964.

VII. DUNNAGE, RELATED PLANT MATERIAL AND ARTIFACTS

The dunnage (or branches laid over the bottom of the hull to protect it from the ballast stones) was exceptionally well preserved. So too were the remains of fire-wood and some perishable artifacts that had survived because they were enclosed within this mass of plant material.

The dunnage itself consisted mostly of shrubs, such as *Phillyrea* and bracken, typical of the *maquis* that grows around the shores of the Mediterranean, as well as some branches that were possibly from fruit-trees (see Diet, p. 60). Unlike the timber used in the construction of the ship, this plant material could not have been imported, but must have been gathered within walking distance of the place where the ship was being built. Consequently should any specimen, or combination of specimens, prove to be diagnostic, this evidence would be one of the best clues to the location of the shipyard.

Unfortunately the plants are of common species, but that is no reason to omit them from this report, because in the future a botanist specializing in the *maquis* of, for instance Pantelleria, might find them significant. Alternatively when other wrecks have been excavated, comparisons between dunnages should prove enlightening.

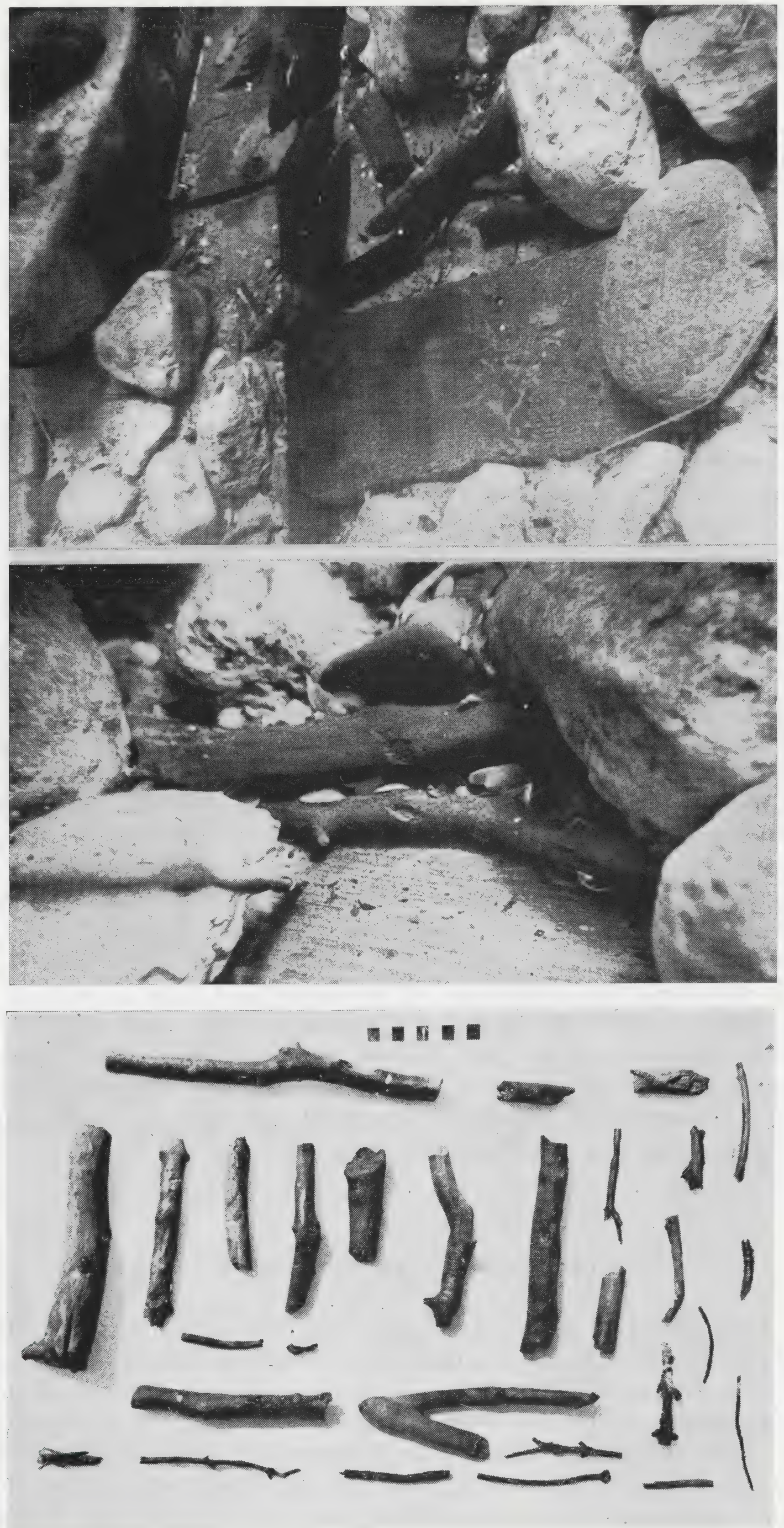
The dunnage of this ship holds further meanings relating to both dating and architecture. Obviously the best material for carbon 14 testing came from branches of no more than one year's growth selected from the dunnage (see p. 45). In addition, any potsherd found within this mass was guaranteed to have sunk with the ship (since the plant material would have perished had it not been immediately sealed into the seabed by sand as soon as the ship settled onto the bottom). In an area strewn with wrecks where intrusive material abounds, it is on the sherds from these " closed " areas that dating must be based.

Within the wreck, the distribution of brushwood and rope as well as dunnage is a clue to missing parts of the ship's structure such as the partitions that must have extended down the middle of its hull. Though these had disappeared (having probably come loose during the sinking) the concentration of organic matter in the central " kitchen area " testifies that some barrier had held it in place there long enough for the sand to have gathered over it and sealed it down.

The Distribution of Plant Material in the Wreck

When a ship strikes the bottom, several factors govern the redistribution of its contents. The law of gravity will be modified in underwater conditions, the most obvious modification being that some things will float. Heavy, loose and un-buoyant objects will, however, still tend to be projected out of a hull if the ship hits the bottom with a jolt, whereas similar but lighter objects will not be carried so far, if indeed they spill out of the hull at all.

Buoyant and fragile material such as brushwood, floats away unless it is trapped in some enclosed space such as a cabin. Even so, its survival would be doubtful unless it



a

b

c

Fig. 31. – *a-b*) Dunnage *in situ* between ribs and held down by ballast stones; note the end of a small oak plank (botton right in *a*) laid over the ribs as part of a gangway parallel to the keel (see fig. 8); *c*) Samples from this area suggest a variety of different plants.

was further contained in boxes or baskets which were in turn quickly buried under sand or mud and thus excluded from both the oxygen in the water and any further movement that would damage them.

There is yet another less obvious process that occurs when a ship sinks. A hull moves up and down before finally settling. Known as " pumping ", this movement causes some of the ship's lighter contents to be sucked down and eventually to be trapped underneath the wreck. All these processes were involved in the redistribution of the contents of the Punic Ship.

Fig. 32. – Examples of the dunnage shown in fig. 31 *a–b* conserved by freeze-drying; they are cut in short lengths presumeably to fit crosswise between the ribs.

It will be remembered that the intact stern had been driven into the bottom by some impact, such as ramming, so that the keel remained stuck in the seabed at an angle of 7° (see fig. 72).

It was not therefore surprising to find *in situ* in the narrowest extremity of the keel–cavity, the compact brownish peat-like " gunge " compounded of bilge, the remains of food such as olive stones and nutshells, carpenter's shavings and chippings, also small leaves and twigs from the dunnage (see fig. 76).

The water being shallow, the prow of the ship must have protruded above the surface on sinking, so the ship must have broken her back almost immediately. The break occured amidships, in the region of the kitchen whence the lighter con tents spewed out and were drawn under by " pumping " before the broken keel settled firmly on top of them.

Simultaneously, the ship had listed to port and her starboard side broke loose. Two results followed: the heavier cooking pots and ballast stones from this central section were projected outwards to port, beyond the remains of the hull itself, while the lighter sherds and brushwood that had not been trapped under the central break in the keel, were sucked down through the break in the starboard side, eventually being trapped under the keel towards the stern; they lay mostly on its starboard side (see fig. 73).

Finally, on the well preserved port side of the hull, some remnants of the dunnage proper remained *in situ* between the ribs where they were held down by those of the ballast stones that had remained in their original positions (figs. 31 and 32).

PROOF THAT THE SHIP SANK WHEN NEW; THE " BROOMSTICK "

Many of the leaves we found were still greenish, and none had turned into skeletons (as leaves usually do after long immersion), presumably because decay had been arrested by immediate sand-burial in the anaerobic environment peculiar to this wreck (fig. 33). It was fresh-looking leaves and twigs embedded in putty that showed that the ship had

TABLE III.

DUNNAGE

Identifications by Plant Anatomy Section, Jodrell Laboratory, Royal Botanic Gardens, Kew.

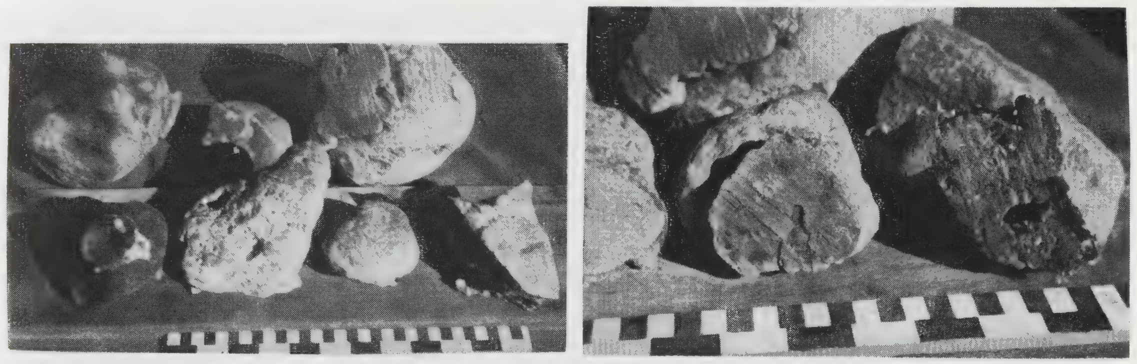
SITE NO.: DESCRIPTION	PROVENANCE ON FIG. 73	IDENTIFICATION	DATE
Samples chosen from boxes of "gunge" submitted in 1971. "There are probably more species than we have recorded but it would be a very time consuming process to track them down".	Keel cavity	Myrtle, *Myrtus communis* L. The rachis of a fern, probably *Pteridium* *Phillyrea* sp. *Pistacia* sp. probably *P. lentiscus* L. (*P. terebinthus* less likely) *Cupressus sempervirens* (small shoot of)	13.6.72 13.6.72 13.6.72 13.6.72 25.1.74
SI/B5/72 The "broomstick".	Under floor-timber 24 Plan	*Phillyrea* sp.	6.4.73
SI/BI/72 Limb with facet-cut end.	By keel scarph	*Quercus* sp. of *Q. cerris* group	6.4.73
SI/A1 and 2/72 Branches	By keel scarph	*Phillyrea* sp.	6.4.73
Samples chosen from 1972 box of "gunge"	Keel cavity	*Phillyrea* sp. Olive stones and leaf fern rachis probably *Pteridium* sp.	6.4.73
Sample from box of dunnage 1973	Keel cavity	Young shoot of *Cupressus sempervirens* L. (Mediterranean Cypress)	18.10.73
SI/34-/74 Sample from box of dunnage 1973	"Kitchen area"	Top of a small shoot of *Cupressus sempervirens* L. The remains of a small Dicot stem too immature far identification	19.2.74
SI/34-/74 Sample from box dunnage 1973.	"Kitchen area"	Leaf a member of the *Oleaceae*, probably a species of *Phillyrea* rather than *Olea*	
SI/81/74	"Kitchen area"	Two small branches *Myrtus communis* L.	28.1.75
SI/99/74	Under keel by besom	*Pinus* sp. of the Sylvestris group	
		Visually identified in Sicily: Nut shells pistachio, almond, hazel. Branches of cherry or apricot trees.	

been built in haste and had sunk shortly afterwards. The use of this putty as a filler and as an adhesive inside the hull is discussed later, in relation to methods of construction. At this point it is only relevant to mention that normally, the putty in the bottom of a hull would have time to harden while the building work continued on the superstructure. Only after the completion of the ship, would dunnage and ballast be laid inside it.

a b

Fig. 33. – *a*) Leaves of *Phillyrea* on discovery underwater still retained their natural appearence; *b*) but they darkened when conserved by embedding in plastic.

But in this case, all the ballast stones that had come in contact with putty were firmly stuck into it, showing that it must still have been very soft when the ballast was loaded (fig. 34). Further, the dunnage branches had already been to hand inside the hull, while the skeletal timbers were being nailed into its shell! One leaf was, for instance, sandwiched between the tip of rib no. 20 and the putty beneath it (fig. 35), while very small twigs and the "broomstick" were embedded in the lump of putty underneath floor-timber no. 21 (on the port garboard just above the level of the keel) (fig. 36).



a b

Fig. 34. – *a*) Ballast stones that had been loaded while the putty the carpenters used was still wet; *b*) the same turned to show the imprint of the hull planking on the putty adhearing to their undersides.

That these most delicate little twigs had neither decayed, nor had they had time to be broken off by objects floating about in the bilge-water, proves that the ship sank when new. That she had been built in haste is also proved by the fact that the dunnage and ballast had been introduced at such an early stage.

As to the "broomstick" (SI/B5/72), one end of it had appeared during the last days of the 1971 season. Having lifted floor-timber no. 19 and loosened the packing in the keel-cavity, we were surprised to see the end of a yellow and apparently freshly whittled stick.

It did not yield to a gentle pull, so we assumed it must be as long as a broomstick (which it otherwise resembled). The keel-cavity was refilled and the stick left there until the 1972 excavation revealed that it was only 64 cm. long, but that it was embedded in the putty that had served to steady floor-timber no. 20 before the latter had been secured by nails (fig. 36). Made of *Phillyrea* (the bark having been removed by knife), both ends of the stick had been wittled to blunt points. Since a pot of paint had been spilled over the starboard planking opposite this trapped stick, it is tempting to imagine that it had served to stir the paint pot and we may picture the shipwrights waiting impatiently with the floor-timber no. 20 in their hands during the accident, then pushing it down home into the putty before the painter could retrieve his stick.

Compacted "Gunge" in the Keel-Cavity

The "gunge" *in situ* in the bottom *stratum* of the aftermost part of the keel–cavity, differed from both the dunnage proper and the brushwood from the kitchen, not only in its peat-like consistency, but also because it contained no *large* plant material, only leaves, small tips of cypress shoots, the rachis of ferns, the nutshells, olive stones, an odd stalk of "cannabis" and the carpenter's chippings and wood shavings. The absence of larger branches implies that the keel cavity must have been partitioned off from both the dunnage and ballast along side it in the bottom of the ship's hull, and from the brushwood and other organic contents of the "kitchen area". Indeed the eatables, like the wood-shavings, might have dropped into the keel-cavity during the construction of the ship. The brownish colour and peat-like consistency of the "gunge" is probably attributable to the bilge in the bottom of the ship. But again, the leaves could not have been floating about in it for long before the ship sank (see fig. 76).

Logs and a Branch

Mixed with the masses of plant material from the kitchen were artifacts of like weight (the bones and pottery are discussed elsewhere). The only storage space in an oared ship being down its centre, such things as cordage as well as firewood would have been kept there.

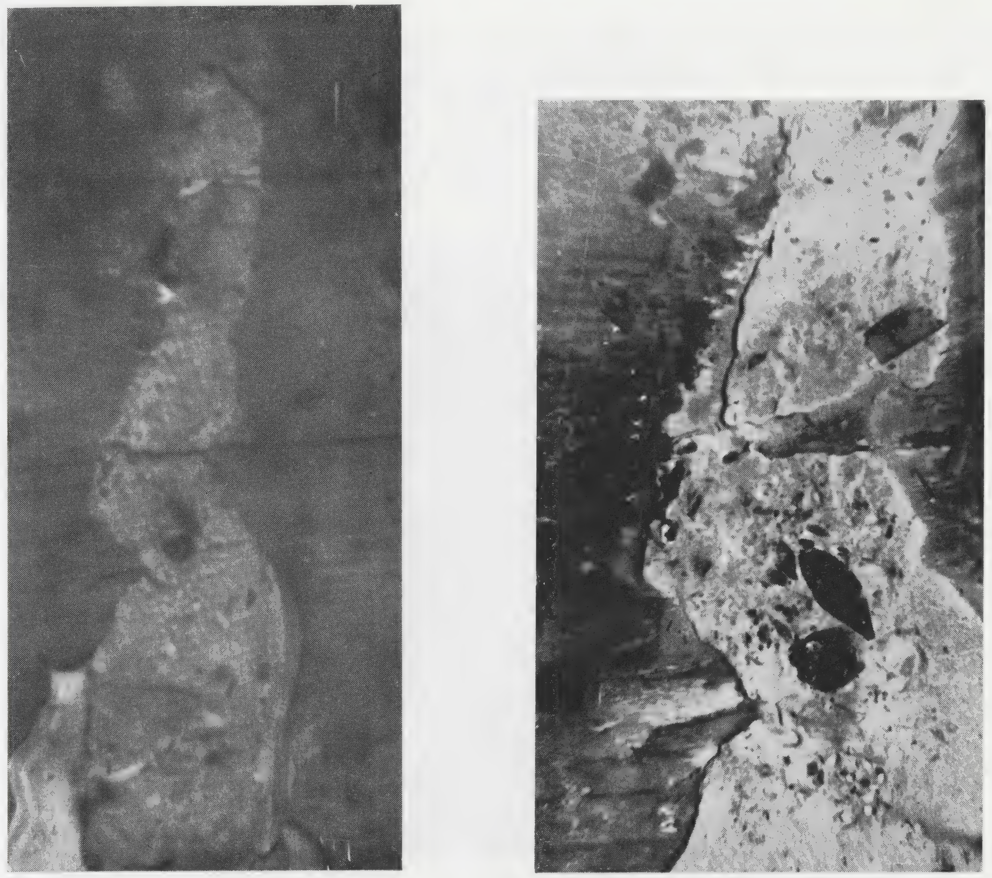
Catalogued as "the big branch" (B1/72) was a straight, 140 cm. limb of oak of the *cerris*, or southern group (fig. 37).

Though covered with bark, it was facet-cut at one end and cannot be classed as firewood. Twelve similar limbs were found in the Kyrenia Ship's hull (1).

Though these were not facet-cut, their general similarity suggests that there may have been a particular use for this kind of limb aboard ancient ships.

Apart from this branch, the *cerris* species of oak is rare on board the Punic Ship and nowhere found in its basic hull-structure; the only other example of it being a tenon in the

(1) Michael L. Katzev, *A Greek Ship is raised*, in *Expedition* 12, 4 Pennsylvania 1970, pp. 9 and 11.



a *b*

Fig. 35. – *a*) The remains of putty adhearing to the hull after rib no. 20 had been raised; *b*) A close-up showing a leaf from the dunnage that had been trapped between this rib and the putty, thus giving further proof that the dunnage and ballast were being loaded while the carpenters were still working in this new ship.

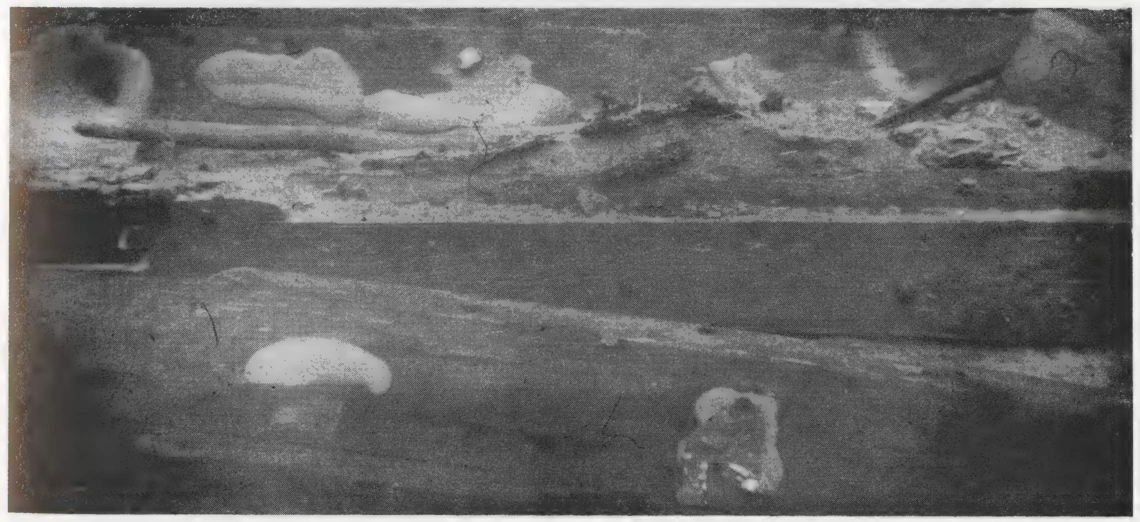
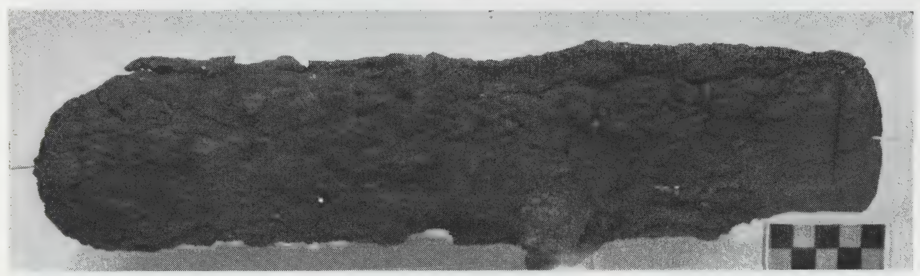


Fig. 36. – The "broomstick" embedded together with dunnage material in a lump of putty (that had supported floor-timber no. 21), as revealed when the starboard side of the ship was removed from the keel. These starboard garboards are seen in the foreground, as they were laid down after they had been detached.

Fig. 37. – *a*) The " broomstick ", a whittled branch of *Phillyrea*;
b) The " big branch ", a limb of *Quercus cerris* facet-cut at one end.

very narrow maple planking (S1/34/74) which, though also found under the keel (N 16 on plan fig. 73) was probably from the ship's superstructure. The ribs of the Punic Ship were predominantly *Quercus robur*, but the two rib samples from the Sister Ship were both *Quercus cerris*, which suggests the possibility that the two ships had been built in different yards, one where there was a good supply of *robur* and one where there was not.

a



b

Fig. 38. – *a*) A firewood log from the "kitchen area"; beyond it, the peg bottom of an amphora and to the right a lenght of rope emerging from the sand. *Photo by J. Blair, National Geografic Society, U.S.A.*; *b*) The same log after the conservation.

Near this " big branch ", outside the starboard side of the hull, lay three logs (Plan fig. 8; P17 and 18) none longer than 40 cm. irregular in shape, all with bark on them and all axe-hewn an the ends (B2, 4 and 4a/72). When examined at the *Istituto Coltivazioni Arboree*, as they were being put into the conservation tanks, two of them were considered to be almond wood and the third sweet chestnut (*Castanea*).

The following year another axe-hewn log (S1/00/73) about three metres distant along the keel in the "kitchen area", lay beside the eye-splice and other bits of rope (figs. 37 *a*; 38).

Similar logs were found later, but always within the same area: between the starboard ballast, the keel and the " kitchen ", i. e. where the major concentration of crockery and food remains also occurred. Taking into account the angle and spread of the sunken ship, these logs alone would suggest that the cooking took place amidships.

In addition 3 pieces of charcoal were found; two of them from closed keel-trenches (S1/409/72 7 152/74). The third (S1/408/74) may have been intrusive, because it came from the surface of the port ballast.

Buttons and a Besom

Among so much archaeological material - not excluding the human bones - it was the handling of three small objects that shocked us out of our routine, vividly evoking the dead Punic sailors. They were: a wooden and a bone toggle (fig. 39) and a little brush,

a

b

Fig. 39. - *a*) A wooden toggle after freeze-drying; *b*) amphora corks after the conservation.

or besom. Toggles are not unusual, but never outside Egypt had such a besom survived in so perfect a state. Indeed a very similar specimen, thought to be Roman, was acquired in Egypt for the Ashmolean Museum, Oxford (n. 439), but only the solid part of its head remains.

a

b *c*

Fig. 40. - *a*) The besom *in situ* underwater; *b*) as lifted; *c*) after conservation.

The besom and bone toggle were underneath the port side of the hull (the wooden toggle came from higher up the starboard ballast pile). The besom lay alongside the narrow maple-wood planking (Plan fig. 73 P16; and fig. 39) in a mass of string and dunnage,

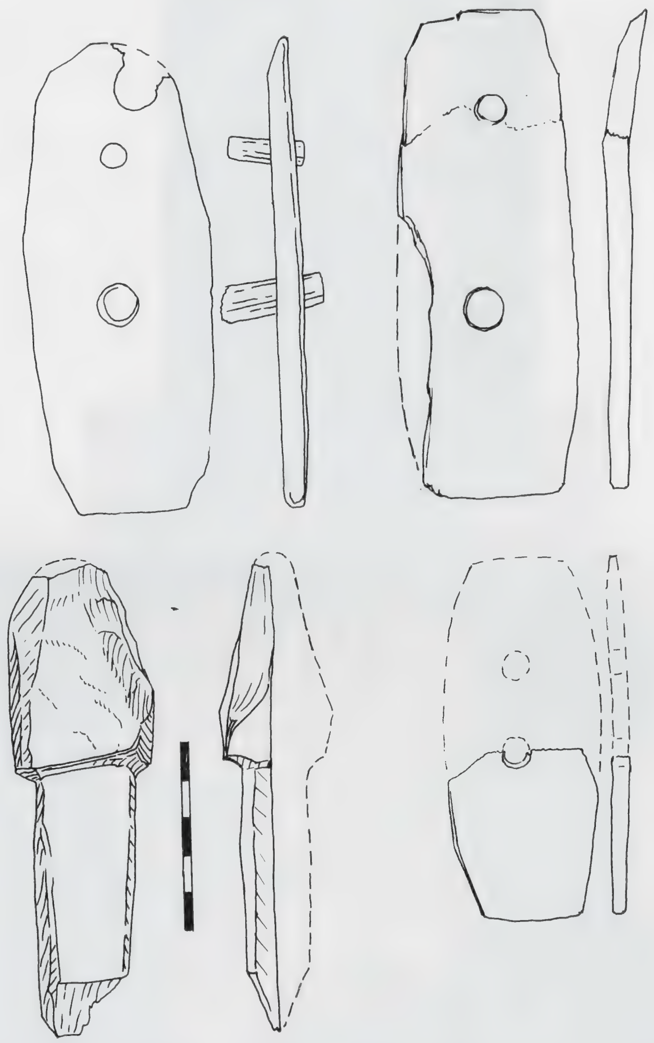


Fig. 41. – Bottom left, the "bung" (SI/26/73); also examples of tenons. Top left, the third piercing shows that this tenon united a scarph; in general the larger tenons were used in the upper part of the hull (1 : 2).

where a bunch of the twigs had been tied together, perhaps to make an improvised broom (fig. 40).

The besom, made of esparto grass, was extremely delicate and difficult to handle (see notes on its conservation, p. 47).

A Bung ? (S1/26/73)

A mushroom shaped object made of oak (now split in half through the centre) was discovered beneath the port side planking. Its use has not yet been established (fig. 41).

Fig. 42. – A marlin spike conserved by freeze-drying and mounted over samples of string embedded in plastic.

Marlin Spikes (S1/250a and b/74)

Finally, before turning to the cordage, it is appropriate to end this section with two marlin spikes (such as sailors' still use in splicing ropes) (fig. 42).

They were found near the eye-splice (described below), among the remains of the thickest ropes, in the " kitchen area ". They had been whittled out of a white wood; no identification was sought, as the objects were immediately handed over for treatment (unfortunately, the smaller of the two perished in the process; it was the conservator's only casualty).

Honor Frost

VIII. CORDAGE

Very large quantities of rope and string, all made of esparto grass (*Stipa tenacissima*) were found annually. A representative collection of samples was selected by James Wolfe-Murray, who drew up the typology shown in fig. 43.

This cordage was the most difficult material with which we had to contend. In delicacy it rivalled the besom and the decayed lead, but whereas the functions of both were already known, so that they just had to be " lifted ", the purpose served by a string or rope could only be ascertained by following it throughout its length. Cordage being usually tangled this was technically impossible, because no rope lay in a continuous and conveniently horizontal line in a single stratum of excavation.

Table IV.

Cordage

Identifications by Plant Anatomy Section, Jodrell Laboratory, Royal Botanic Gardens, Kew.

Site No.: Description	Provenance fig. 73	Identification	Date
SI/404-/72 SI/404-/72 SI/404-/72 All 30 mm. rope	Under keel	" All three samples: *Stipa* sp. probably *Stipa tenacissima* L. or 'esparto grass'	6.4.73
SI/73 A. Rope fragment with whipping B. Eye splice fragment C. 30 mm. rope D. 30 mm. rope	A. Keel area B-D " Kitchen area "	" All four samples made of a grass having a structure which agrees with *Stipa tenacissima* L., esparto "	19.2.74
SI/T2/74 Plaited cord from " shield holder " SI/135, 136, 137/74 Ropes SI/339/74 Thick string SI/340/74 Thin string SI/341/74 Thick plait SI/342/74 Medium plait SI/343/74 Thin plait	fig. 73, *10* " Kitchen area " Keel area Plan " Kitchen area " " Kitchen area " " Kitchen area " " Kitchen area "	" All the specimens examined were composed of grass. It was found that their structure agreed rather more closely with *Stipa tenacissima* Korth than with *Ampelodesmos Mauritanica* (Poir.) Dur and Schinz and other grasses which were also compared with this material "	28.1.75
Besom	fig. 73, P14	Made of a grass similar to *Stipa*	

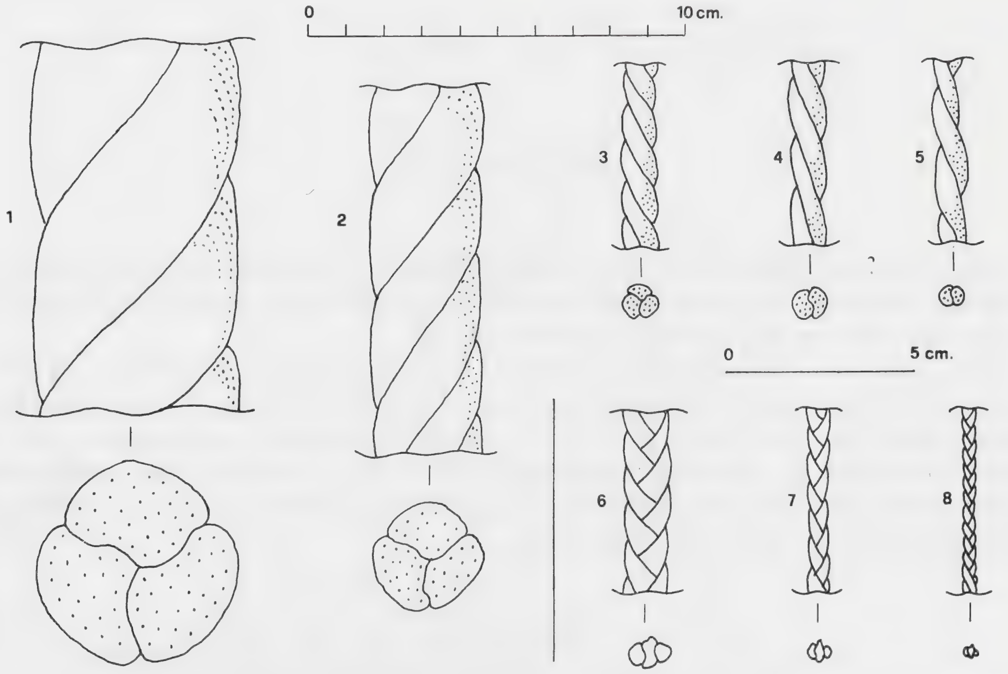


Fig. 43. – Ropes: 1) (SI/335/74) Thick rope: laid, or twisted, to the left; 55 mm.; three strands each of 30 mm.; 2) (SI/337/74) Thin rope: laid to the left; thickness 30 mm. three strands each of 20 mm.; 3) (SI/338/74) Cord: laid to the right; thickness 10 mm.; three strands each of 5 mm.; 4) (SI/339/74) Thick string: laid to the right; thickness 10 mm. two strands of 5 mm.; 5) (SI/340/74) Thin string: laid to the right; thickness 80 mm. two strands of 24 mm. Plaits: 6) (SI/341/74) Thick plait: thickness of 12,5 mm. of three strands each of 7,5 mm.; 7) (SI/342/74) Medium plait: thickness 6 mm. of three strands each of 4 mm.; 8) (SI/343/74) Thin plait: thickness 4 mm. of three strands each of 2 mm.
Drawings by James Wolfe-Murray (1 : 2).

It can, however, be deduced from the distribution plan fig. 73 in grids P 16–20 and N 26–29, also N 15, that a considerable length of the 30 mm. rope (no. 2 on fig. 43) had been trapped beneath the hull. The first piece was seen beneath the port planking in 1971 (N 15 on the plan fig. 73); the similar fragments were found beneath the keel in 1973 and again further forwards along the same line in 1974 (fig. 44).

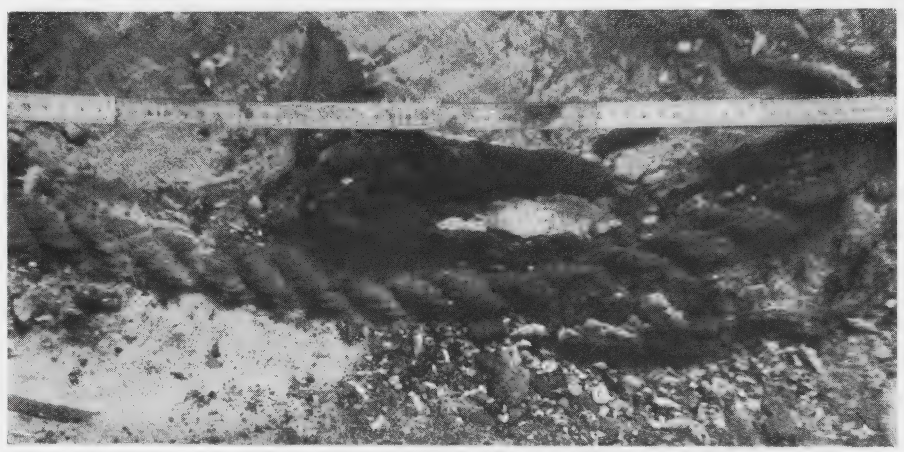


Fig. 44. – Rope found under the hull; on top of it the dark and powdery remains of lead sheathing.

Fig. 45. – A liburnia from Trajan's Column; note the use of rope on the prow. *Photo L. Basch.*

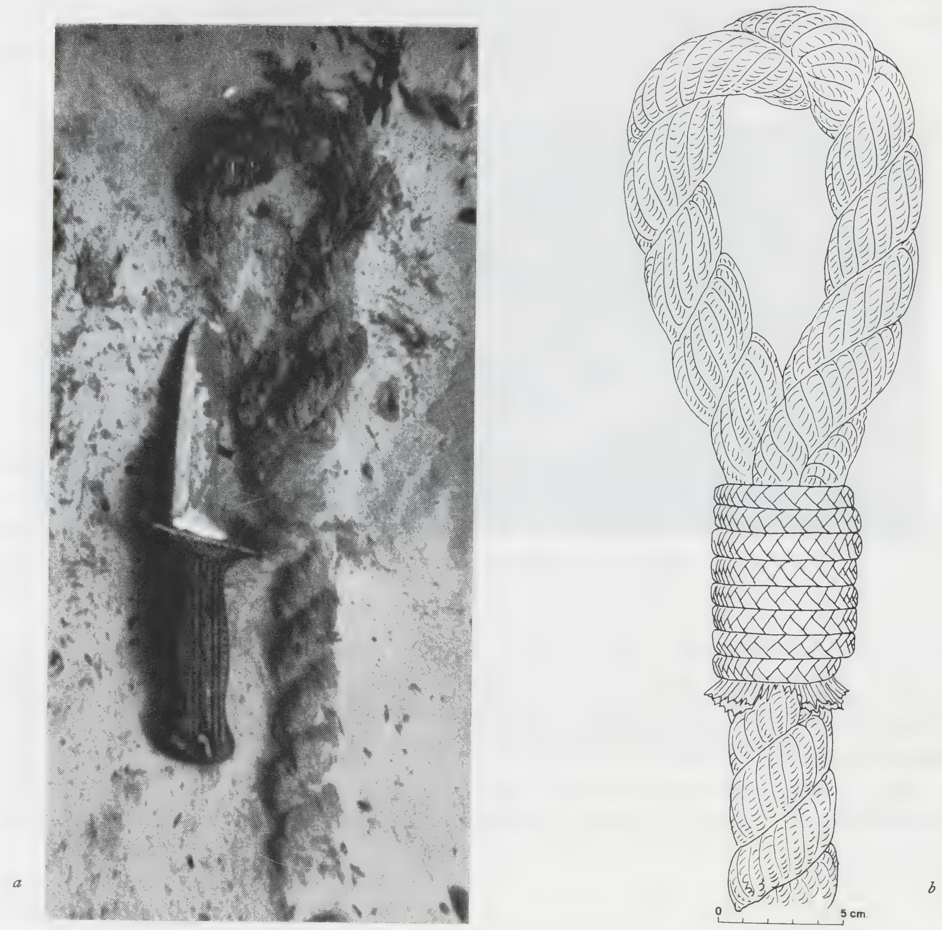


Fig. 46. – *a*) The eye-splice as found underwater; *b*) drawing of the same (1 : 3).

This rope under the hull evokes the *hypozomata*, or girdles that were used particularly around warships, to hold together the hulls which were under constant strain from the working of the oars, and also to prevent them from going to pieces under a shock such as ramming (1). Grooves on the length of wale which is discussed below (p. 255), again suggest this use of rope. 30 mm. ropes would, however, seem small for the purpose and it is thought that a 50 mm. diameter would have been required. In any case, ropes which have multi-various uses on modern ships probably had even more on the ancient. One liburnia, in bas relief on the Trajan Column shows, for instance, a rope which appears to be reinforcing the fore-deck above the ram, fig. 45.

On this wreck, most of the cordage occurred in the " kitchen area " which, as we have seen, was also the main storage space. Here, every strand in our typology was represented, and here by the marlin spikes, we found the eye-splice, fig. 46.

The Eye-Splice

Made of the 30 mm. three strand rope, laid (or twisted) to the right, with certainly no more than two tucks (possibly only one), the splice is whipped with plaited string.

After examining the drawings and photographs, ' two old bosuns ' wrote: " *this would be very much the same as we have spliced for the last few centuries, except we are doubtful if it would be very strong if it only has one twist* ". (I am indebted to Lt-Cdr. W. E. Pearce, M. V. O., R. N. Rtd. and Lt-Cdr. H. A. Twiddy, C. O. of HMS " Victory ", for this opinion).

Fig. 47. - The thickest rope (type 1).

Apart from its lack of strength (the Manual of Seamanship rules *at least* two tucks for eye-splices in rope) the only unusual aspect of this Punic splice is its whipping of plaited string. (I am obliged to Mr. Frank Howard for pointing out that plaited string is widely used for whipping and binding in South East Asia and the Pacific Islands).

The uses of the remaining cordage are unknown, with the following exceptions: the 8 mm. string around a bunch of twigs (possibly an improvised broom); the knot was, unfortunately, missing.

(1) C. Torr., *Ancient Ships*, Cambridge 1894, p. 42.

The 12.5 mm., plaited cord associated with Basket no. 1, had obviously been looped around it, so as to form the handles, as in the *koffa tunisia*.

The thickest, 55 mm. rope could have borne the weight of an anchor, fig. 47.

The two larger ropes of fig. 48 are laid to the left; according to the Sicilian rope-maker who demonstrated the traditional technique in the Latomie at Syracuse, the direction of the lay has no particular significance. His ropes are of hemp, and he has never heard of esparto being used in Sicily. Nor is it used currently elsewhere in Europe; hemp, sisal and to a lesser degree, manilla fibres were almost universal until the advent of nylon.

Fig. 48. - Samples of three thicknesses of rope. *Photo by F. Campbell.*

During the Classical period, hemp and esparto receive almost equal mention (though some papyrus probably continued to be used). Athenaeus' famous description of the building of the great freighter by Hiero II of Syracuse gives the cordage as: hemp from the Rhone Valley and esparto from Spain. Pliny (*N. H.* 19,30) refers to the good quality of Spanish esparto, while Livy (22.60.6) informs us that Hasdrubal, the founder of Carthagena, collected vast quantities of this grass to make ropes for his navy (between the First and Second Punic Wars).

Little cordage has been retrieved from ancient wrecks. On the Nemi Ships, both hemp and esparto ropes were present (the latter is said to be Libyan esparto) (2).

Honor Frost

(2) Ucelli, *op. cit.*, p. 268.

Note on the Botanical Components of the two Punic Ships

The identification of ancient plant remains is frequently possible by a microscopal study of the cellular structure. The appearance of plant cells differs from species to species, or at least from genus to genus, and an experienced plant anatomist is able to compare unknown material with a comprehensive reference collection of microscope slides. Plant material from the Punic Ships has been examined by Mr F. R. Richardson, Dr. D. F. Cutler and Dr M. Y. Stant, at the Jodrell Laboratory, Kew. I helped to sort the material and extract specimens; it is now my task to assemble the identifications in a logical manner for the record and for the non-botanical reader.

The specimens from the Punic Ship are fairly numerous, but during the brief sounding made on the ram of the Sister Ship far fewer were raised. Nevertheless it is worth considering them together, because it is a unique opportunity for comparing two ships of the same "nationality" and period. A good deal more research will be necessary before a definitive account can be prepared. Thus, for example, the question of the geographical region where the Punic Ship was constructed might eventually be resolved by deducing the provenance of its dunnage, and possibly the relation of these plants to the type of soil suggested by M. Mascle's study of the ballast stones. In this respect the timbers themselves are less diagnostic, because the timber trade is known to have fluorished in antiquity, so that unlike the freshly cut branches the constructional wood is more than likely to have been imported.

Pine

As described earlier in this report, large portions of the Punic Ship's structure were still in reasonably good condition by the time they reached Kew. The planking of both ships was made of pine (see Table II), as was the central portion of the keel; no sample was taken from the Sister Ship's keel. Now the pine most likely to have been used is the Corsican pine (*Pinus nigra*, var. *laricio*) which is readily available in the central Mediterranean area, although it is not possible from anatomical examination to get a more precise identification than to say that it belongs to the "Sylvestris group" to which this Mediterranean species belongs.

The side arms of the Sister Ship's ram are, however, made of a pine with different types of intercellular wall pitting characteristic of the group called "Ponderosa"; the Maritime Pine (*P. pinaster*) of south west Europe to Southern Italy is one which has this structure.

Oak

Oak wood being hard and strong, it is not surprising that it should be used for dowels and tenons as well as the skeletal structure of the ship.

To judge from those samples that were taken from the ribs of the Punic Ship, oak of the *Quercus robur* type predominates. Of these 7 rib samples, only one is made of *Acer* (floor-timber 19, or SI/30/71). Miss Frost informs me that of the 29 surviving ribs, 25 had the distinctive veining she associates with oak, the remainder were different: probably maple, but this is only the excavator's visual impression.

The *Q. robur* type includes the English oaks: *Q. robur* and *Q. petraea* as well as certain Mediterranean species.

On the Punic Ship, the southern species, *Q. cerris*, has only been found among the tenons of the narrow maple planking (SI/P34/74) and the carpenter's shavings (which must have fallen into the bottom of the hull while men were still working above). On the Sister Ship, by contrast, both rib samples were of the *Q. cerris* type oak, as was the long section of wale (TX/7/73) which, though it was found on the Punic Ship site could have been washed in from the Sister Ship. The dowels from both ribs and wale as well as a tenon from the wale also differ from those of the Punic Ship, being of olive wood (*Olea europaea*) rather than oak. The oak of the cerris group. e.g. *Q. cerris* and *Q. macrolepis* (which is more often known as *Q. aegilops*) occurs in western Turkey, hence its common name Turkey oak, and extends across southern Europe, while *Q. macrolepis* has a distribution in the Aegean region, the southern part of the Balkan peninsula and south eastern Italy.

Acer

Another of the principal woods used in the construction of the Punic Ship was maple, *Acer sp.* It formed the after section of the keel which rose to become the sternpost; one of the after floor-timbers (19, SI/30/71)

and, if the excavator's observation is correct, three other "ribs". It was also used among the finer woods in the superstructure as testified by the section of narrow planking (SI/P34/74) and carpenters' shavings.

Walnut

Also from the superstructure, the "shield holder" which is transpierced by plaited cords (SI/T2/74) is made of walnut, a resilient wood that is now frequently used for making such things an rifle stocks, and which would better withstand the contact with metal than, for instance, the softer pine. The walnut tree *Juglans regia*, was widely grown by the Greeks and Romans (and probably the Carthaginians as well, see p. 61) who considered the shape of the familiar nut to be similar to a brain and named it after Jove. Its natural distribution is rather obscure, but it appears to be native in Persia (Iran) hence its Greek name *persicon*.

Miscellaneous shavings from the superstructure

As already noted, maple ocurred in the areas packed with organic matter and the fall of chippings and shavings which give a clue to the finer woods that must have been used in the superstructure. There were also shavings of beech, fir, pistachio and cedar.

Beech, *Fagus sylvatica*, is a central and western European tree that follows the mountains southwards as far as central Greece, Sicily and central Spain.

The pistachio could have come from several species of the genus *Pistacia*, probably the terebinth tree (*P. terebinthus*) since it is more woody than the shrubby lentisc (*P. lentiscus*).

If cedar (*Cedrus*) is the correct identification of one of the shavings, then the eastern Mediterranean (Cyprus, Turkey or Lebanon for C. Libani) is a possibility, as well as the Atlas Mountains in the west, where the *C. atlantica* grows.

Dunnage

Though it is estimated that some 16 cubic metres of dunnage and other plant material from the kitchen area were excavated, only small samples of this great bulk could be examined microscopically. Many plants were, however, readily identifiable without the use of high powered microscopes. All the same, one can be misled by superficial resemblances, which need to be checked in detail. Thus, what at first appeared to be olive twigs and leaves proved to be *Phillyrea* (*P. angustifolia* or *P. media*) on closer examination. *Phillyrea* is a small tree that inhabits the dry hills of the northern Mediterranean: it is reasonable to expect the ship builders to have used local, wild material rather than chopping up valuable cultivated olive trees.

Two small branches of myrtle (*Myrtus communis*), *Pistacia* probably *lentiscus* and cypress (*Cypressus sempervirens*), all plants typical of the Mediterranean zone, were also found. Unexpected were several well-preserved stems of bracken fern (*Pteridium aquilinum*) although it does occur even down to sea level in a number of places: the Sorrento peninsula, for instance. The yard where the ship was built must have been one of them since the fern in question must have been gathered up by the ship builders.

The large limb of oak, cut to a point at one end (SI/B1/72) can be mentioned here although, strictly speaking it is too big to have served as dunnage; it came from an oak of the *Quercus cerris* type.

"Cargo"

No cargo as a pay load was carried on these ships of war, but a distinction has to be drawn between the dunnage and the rest of the plant material that was evidently taken on board for a different purpose. In addition to the above mentioned limb of oak, there were logs cut as for firewood and, since there was clear evidence of a galley amidships, it is hardly surprising that a piece of charcoal was found. It was of oak.

Probably also associated with the galley were two baskets. A sample taken from one of them proved to be leaves of a sedge like plant (see pp. 62 and 64).

This basket contained fibrous material that has microscopical characteristics of *Cannabinaceae* to which *Cannabis sativa*, the hemp, belongs. It is therefore tempting to imagine the weary oarsmen slaking their thirst with a solution of the drug prepared by steeping the plant in hot water. The fibrous form of cannabis is often used for the manufacture of cordage and sail-cloth as well as for caulking, but there is no evidence to suggest any of these uses on the Punic ships.

Other samples found mainly in the keel cavity were stones of olive (*Olea europaea*) which had presumeably fallen there after the flesh had been eaten, also an object which could be the rather woody stony

endocarp of a pistachio nut (*Pistacia vera*). The hazel and almond nut shells referred to in the chapter on diet, were not examined in the Laboratory.

All the ropes and cordage retrieved were entirely composed of esparto grass, *Stipa tenacissima*. Most of them were in a very delicate condition, especially on exposure to air where oxidation took place. The well-preserved besom was also made of esparto grass fibres. The design of this kind of handle-less brush is traditional and can be compared with Ancient Egyptian ones (of palm fibres), and even those of the present day still made in the Mediterranean region.

F. Nigel Hepper

The Herbarium, Royal Botanic Gardens, Kew.

IX. BALLAST STONES

What marked this wreck on the seabed were the two piles of ballast stones to either side of its buried keel (Distribution Plan fig. 73). Like icebergs, only a small part of their bulk showed, but beneath the sand the piles united, their stones spreading across the keel-cavity and holding down the remains of the dunnage over the planking. The reason why the stones had come to rest in superficially distinct piles is not hard to explain: if partitions had once enclosed a central storage space over the keel, these would have acted as a barrier separating the ballast to either side of them.

It might be argued that not all the surface stones belonged to the Punic Ship. Modern salt barges coming to the Island to take on their cargoes from the *saline* might well have been carrying ballast which they discarged before loading the salt. That they should have discharged them on this spot is, however, very unlikely, because the water over the wreck is so shallow. It will be remembered that one of the boats that we used during the excavation was itself a *small* salt barge, but despite its size its draft was still too deep for it to be moored over the site, so we had to use a fishing boat and a rubber dinghy (both craft that carry no ballast).

Nevertheless, it is possible that a small percentage of the stones on the surface of the wreck's ballast piles might be intrusive, because as it has been observed on other sites (1) material dropped on the surface of the seabed will be rolled some distance by water movements, only coming to rest where there is either an obstruction or a declivity on an otherwise flat bottom. Thus, had stones been discharged from a barge some way off, currents could eventually have carried a few of them to where the ancient ballast and already stabilished wreck-formation obstructed their further movement.

We cannot be certain whether this occurred over the Punic Wreck, but had it done so, it would affect the interpretations that follow. My own, visual, impression is that it had, because the distinctive black volcanic and white quartz-like stones that characterized parts of the ballast found in contact with the wood of the hull, did not appear among the waterworn stones on the surface of the piles (see below).

Impossibility of Estimating the Total Ballast

No accurate estimate of the total ballast could be made, which is unfortunate because the information would have been useful to those engaged in the architectural reconstruction of the ship. An estimate might still be deduced through laborious calculations based on the excavation records, but it could hardly be sufficiently accurate to be useful. It would, of course, have been possible to have excavated the site in such a way that the information could have been obtained. A powerful dredge could have been used on the ballast, to free it quickly, in only one season, so that the stones could have been examined and their total

(1) H. Frost, *The Offshore Island Harbour at Sidon*, in *IJNA* 2, 1, London 1973, pp. 80-81.

volume calculated. But to have done this would have meant laying bare, once and for all, the delicate wood beneath, without leaving time either for it to have been recorded in detail, or for it to have been lifted with due care. Aiming for as complete a knowledge as possible of the hull, we had no option but to excavate it metre by metre, thus sacrificing the information about the ballast (in using this method the sand, of course, flowed back into the small soundings so that the stones could never be seen as an ensemble).

Method of Taking Samples

During the first and second seasons, when the stern and central part of the keel were being excavated and the spread of the ballast was fairly thin, only representative samples were collected. Quantitative sampling began the following year when M. Georges H. Mascle (whose identifications and comments appear below) himself visited the excavation at the beginning of the 1973 season. By this time the site was deeply buried beneath the aforementioned and accursed sand-bank. It was with difficulty that we freed even the surface of part of the seaward slopes of the ballast-piles for him to see. The quantitative samples were taken there, while we were trenching across the wreck. The stones were removed in large baskets, then carried seawards, beyond the wreck-area, where they were emptied in rows parallel with the shore. As the baskets were emptied, Paolo Giacalone broke the stones, bagging samples from each basketful for identification at the *Département de Géologie Structurale* of the University of Paris VI.

It was only later in the season, after M. Mascle had left, that we reached the stones that were in contact with the wood, i. e. the " sealed areas ", but by this time the excavators had to give their full attention to the recording and raising of the wood. It was impossible to do more than take individual samples of those stones which, to our untrained eyes, looked different from the mixture we had seen on the surface of the piles. During the final season, we also found a scatter of much larger and apparently distinctive stones such as the porphyroid granite (S1/1/74) and the basalts (SI/2 and 3/74) on the landward sides of the central and " kitchen " areas.

Later, by consulting the registers, I extracted a list of stones representative of the " sealed areas " (C 72-1, 73 B 1, 2, 3, 5 and 10 also 73 B 10-1 to C 73 B 10-4 attached to the hull by putty; see identifications lists) which I sent to M. Mascle in case this mixture should differ significantly from the aggregate of the quantitative samples on which he had based his opinion.

He replied in a letter (24.4.76):

" It seems to me difficult to draw conclusions from the rocks coming exclusively from " sealed areas ". Certainly they have their importance, but I think the discussion must rest on a whole, not on a part. It is true that not all the facies are present in the rocks from the "sealed areas"; this is connected with the fact that all the facies except the Cretaceous are represented in small proportions in the whole. One notes in the sealed areas some that are calcareous in 2 facies, besides the eruptive rocks (granite, gneiss etc.) which are certainly pebbles and not block taken from a seam.

Among the " sealed area " samples the olivine basalts and leucotephrites are not local, i. e. from the Trapanese region. The remainder might be. But as I have already pointed out it is the practice in shipyards to re-use ballast that has been left lying around (having been taken out of old hulls). This could well explain the basalts and leucotephrites and similarly the granites identified by Prof. Vianelli (see p. 114). To sum up: there are differences between the rocks from the "sealed areas" and the rest, but these are not very conclusive".

The above will serve to explain our approach and to introduce the impressive list of identifications that follows. Meanwhile these identifications should be kept in mind when

considering other sections of this report, such as the botanical identifications of the dunnage (for example: did the aggregate of the plants grow on calcareous or silicious soils?). Further, correlations may emerge from the research that may continue for many years after this report has been published. A connexion might, for instance, eventually be discernible between the isotopic compositions of the leads used on this ship, the mines they came from and the ballast stones.

Our present, tentative conclusions follow the identifications.

Honor Frost

Identifications d'echantillons de lest

Echantillons transmis à Paris en 1973

C 71–1 Brèche: ??
C 71–2 Brèche: ??
C 71–3 Biosparite à Rudistes et Foraminifères: Crétacé
C 71–4 Brèche: ??
C 71–5 Intrasparite à débris de Mollusques et Foraminifères: Crétacé
C 71–6 Pelsparite à Foraminifères et Ostracodes:?
C 71–7 Biosparite à nombreux Globigérinidés et quartz: Récent (fig. 54 no. *24*)
C 71–8 Biomicrite à Miliolidés et débris d'Algues: Crétacé
C 71–9 Microsparite à Miliolidés et dismicrite: ?
C 71–10 Biomicrite à rares Foraminifères et biomicrosparite à Miliolidés: Crétacé
C 71–11 Pelmicrosparite à Thaumatoporella: Lias?
C 71–12 Intrasparite à Foraminifères: Crétacé
C 71–13 Brèche dolomitique: ??
C 71–74 Pelmicrite à Algues, Miliolidés, Lamellibranches, cataclasée: ?
C 71–15 Pelmicrosparite à Ostracodes, Lamellibranches et rares Foraminifères: ?
C 71–16 Pelmicrosparite et pelmicrite à Miliolidés et Coprolithes, cataclasée: ?
C 71–17 Brèche à nombreux galets dolomitiques et plus rares fragments de pelmicrosparite à Miliolidés:?
C 71–18 Galet: ??
C 71–19 Pelsparite à Miliolidés, Foraminifères, Aeolisaccus, Thaumatoporella, perforations de Lithophages: Lias
C 71–20 Dismicrites à Ostracodes et pelsparite à Algues et petits Foraminifères: Crétacé?
C 71–21 Rudite à ciment sparitique: galets de pelsparite à Algues, biomicrite à Radiolaires, biomicrite à Foraminifères éocènes, grès fins, roches vertes: ??
C 71–22 Pelmicrosparite à Echinodermes et Thaumatoporella: ??
C 71–23 Pelmicrosparite à Aeolisaccus, petits Foraminifères, Cayeuxia, Oncolites: Lias (fig. 51 no. *11*)
C 71–24 Micrite et microsparite à Hedbergelles, Praeglobotruncana, partiellement dolomitisée: Crétacé (fig. 52 no. *13*)
C 71–25 Pelmicrosparite à Ostracodes et dismicrite: ?
C 71–26 Pelmicrosparite partiellement dolomitisée: ?
C 71–72 Micrite à rares débris d'Algues, Ostracodes, Miliolidés, rare quartz: ??
C 71–28 Brèche à ciment sparitique; éléments de dismicrite à Foraminifères Crétacés: ??
C 71–29 Grès calcaire: Récent
C 71–30 Pelmicrosparite à Algues (Thaumatoporella), Miliolidés, Cunéolines: Crétacé (fig. 52 no. *15*)
C 71–31 Dismicrite à rares Ostracodes, partiellement dolomitisée: ?
C 71–32 Pelmicrosparite à Foraminifères (Miliolidés ...) et Algues, cataclasée (n° Si 15–71): ?
C 71–33 Ponce: ??
C 71–34 Ponce: ??
C 71–35 Basalte à Olivine: ??
C 71–36 Dismicrite cataclasée et partiellement dolomitisée: ?
C 71–37 Galet de quartz: ??
C 71–38 Quartz et peu de chlorite: ??
C 71–39 Chert, Radiolaires et spicules: ??
C 71–40 Dolomie: ??
C 71–41 Dolomie: ??

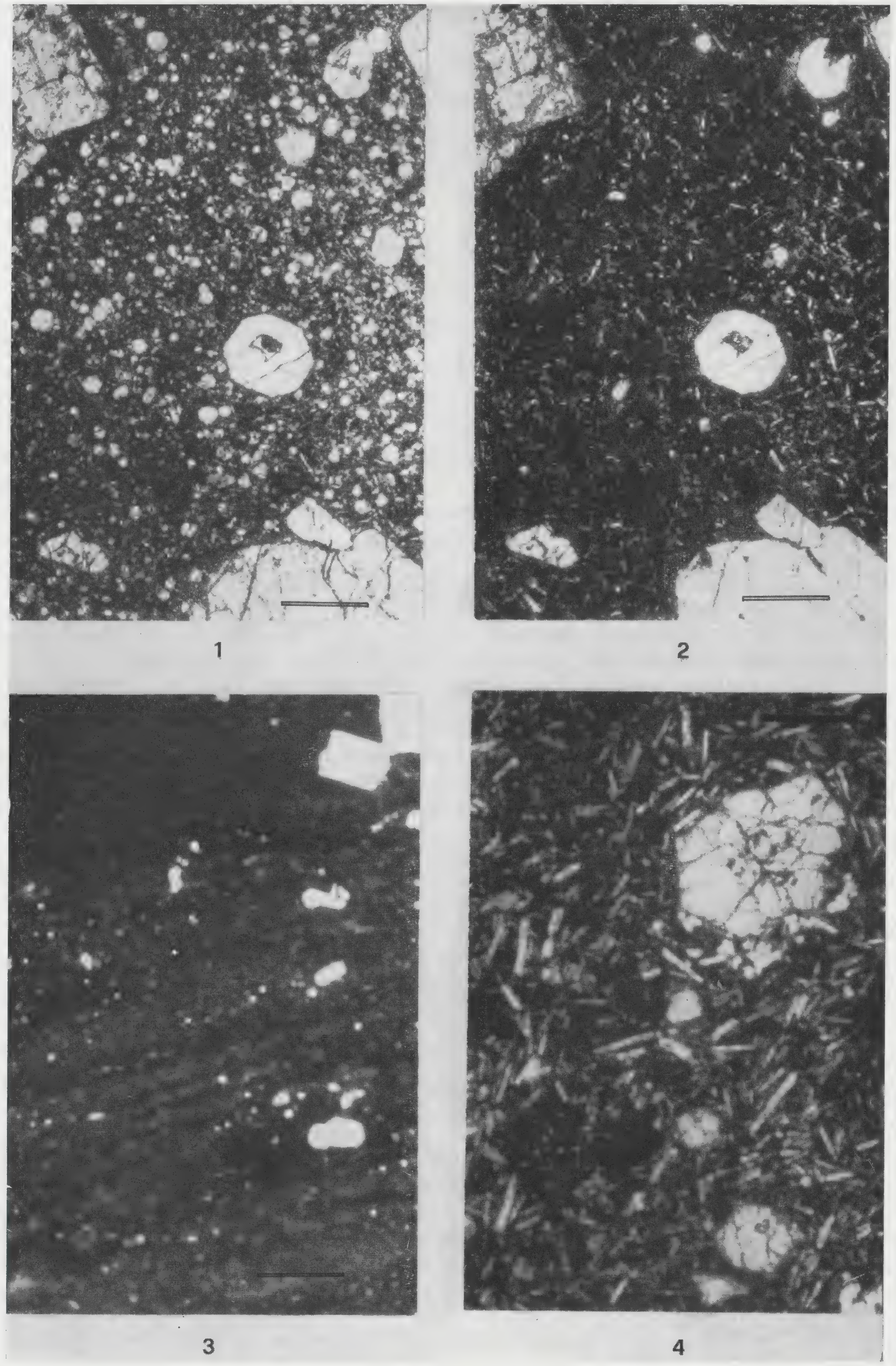


Fig. 49. – *1*) C 73 B 8–6: Leucotéphrite, lumière polarisée non analysée (LPNA); *2*) id.; lumiére polarisée analysée (LPA); *3*) C 73 B 8–3: Hyaloclastite (LPNA); *4*) C 73 B 9–1: Basalte à Olivine (LPNA). Echelle: le trait représente 75 microns.

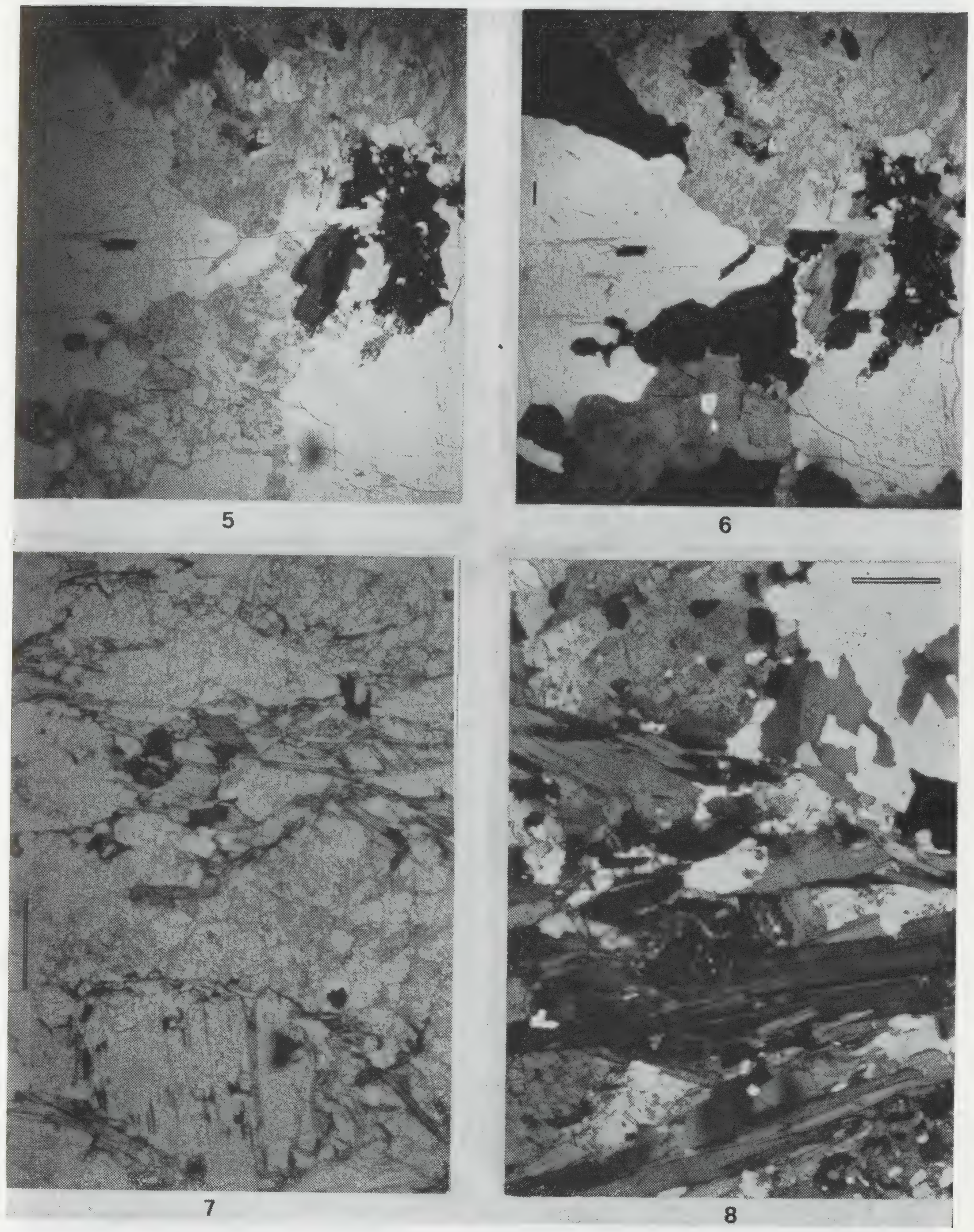
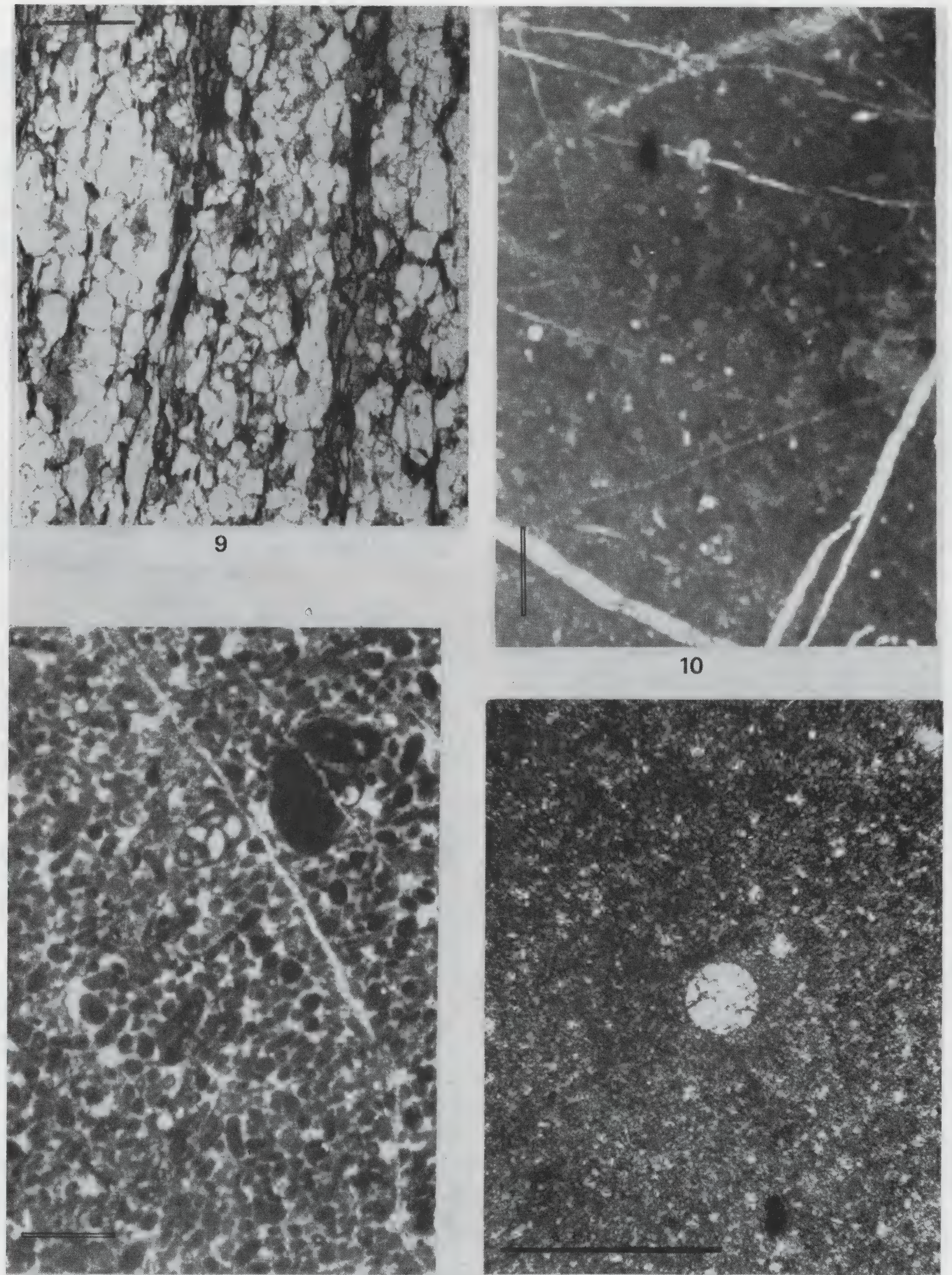
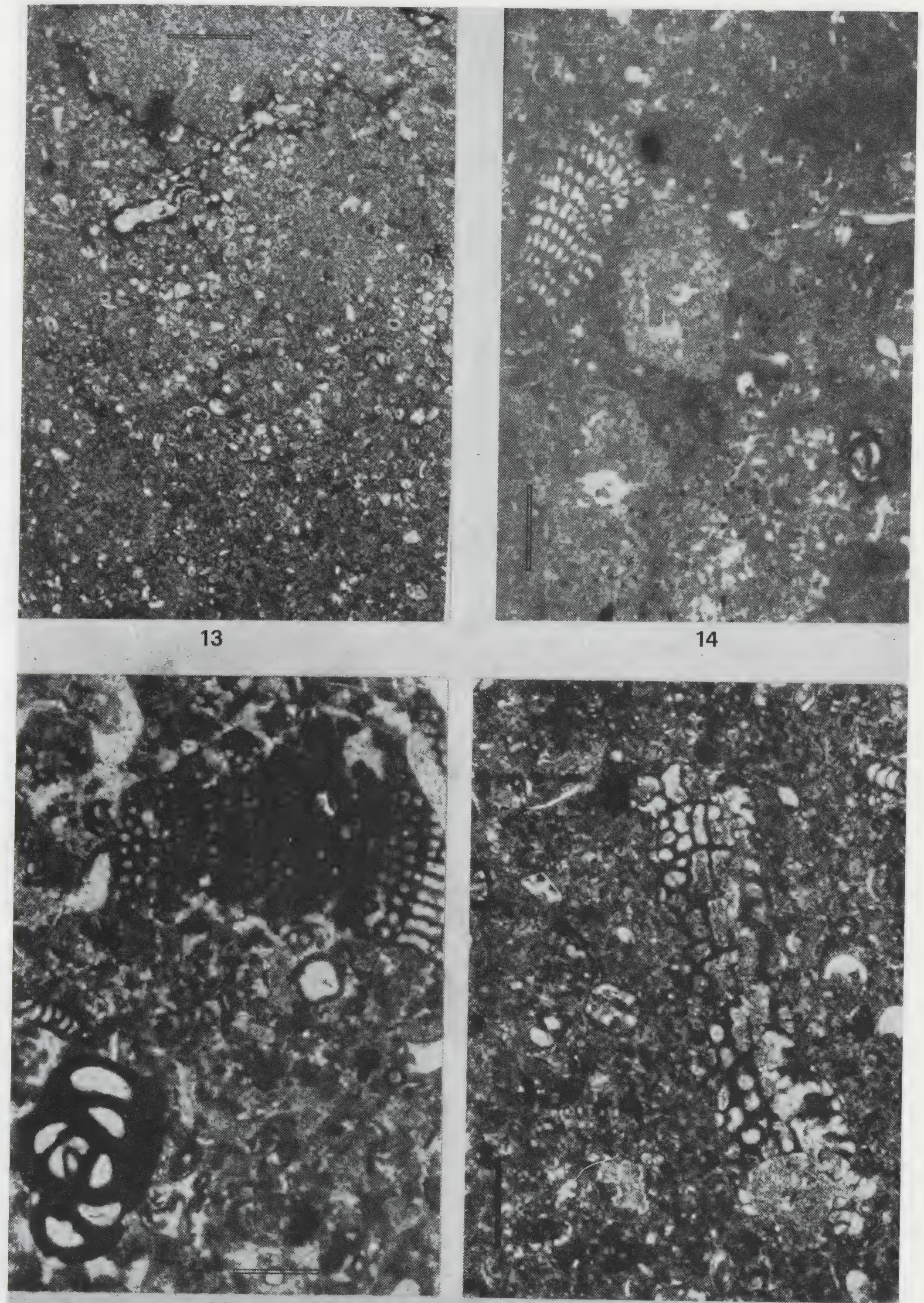


Fig. 50. – *5*) C 73 B 1–1: Granite à biotite (LPNA); *6*) id.: LPA; *7*) C 73 B 1–4: Gneiss (LPNA); *8*) C 73 B 1–7: Gneiss oeillé (LPA). Echelle: le trait représente 75 microns.



9 10 11 12

Fig. 51. – *9*) C 73 B 1–2: Micaschiste (LPNA); *10*) C 73–55: Micrite à rares Halobia et Radiolaires, très cataclasée: Trias (LPNA); *11*) C 71–23: Pelmicrosparite à petites Foraminifères, Cayeuxia, Aeolisaccus, Oncolites: Lias (LPNA); *12*) C 73 B 1–5: Micrite à Radiolaires et Nannoconus: Crétacé inférieur (LPNA). Echelle: le trait représente 75 microns.



13 14 15 16

Fig. 52. – *13*) C 71–24: Micrite à Globotruncanidés partiellement dolomitisée: Crétacé supérieur (LPNA); *14*) C 73–34: Microsparite à Foraminifères, Algues, Pélécypodes, Ostracodes, très cataclastique: Crétacé (LPNA); *15*) C 71–30: Pelmicrosparite à Algues et Foraminifères: Crétacé (LPNA); *16*) C 73 B 12–15: Intrabiopelmicrite à Algues et Foraminifères: Crétacé (LPNA). Echelle: le trait représente 75 microns.

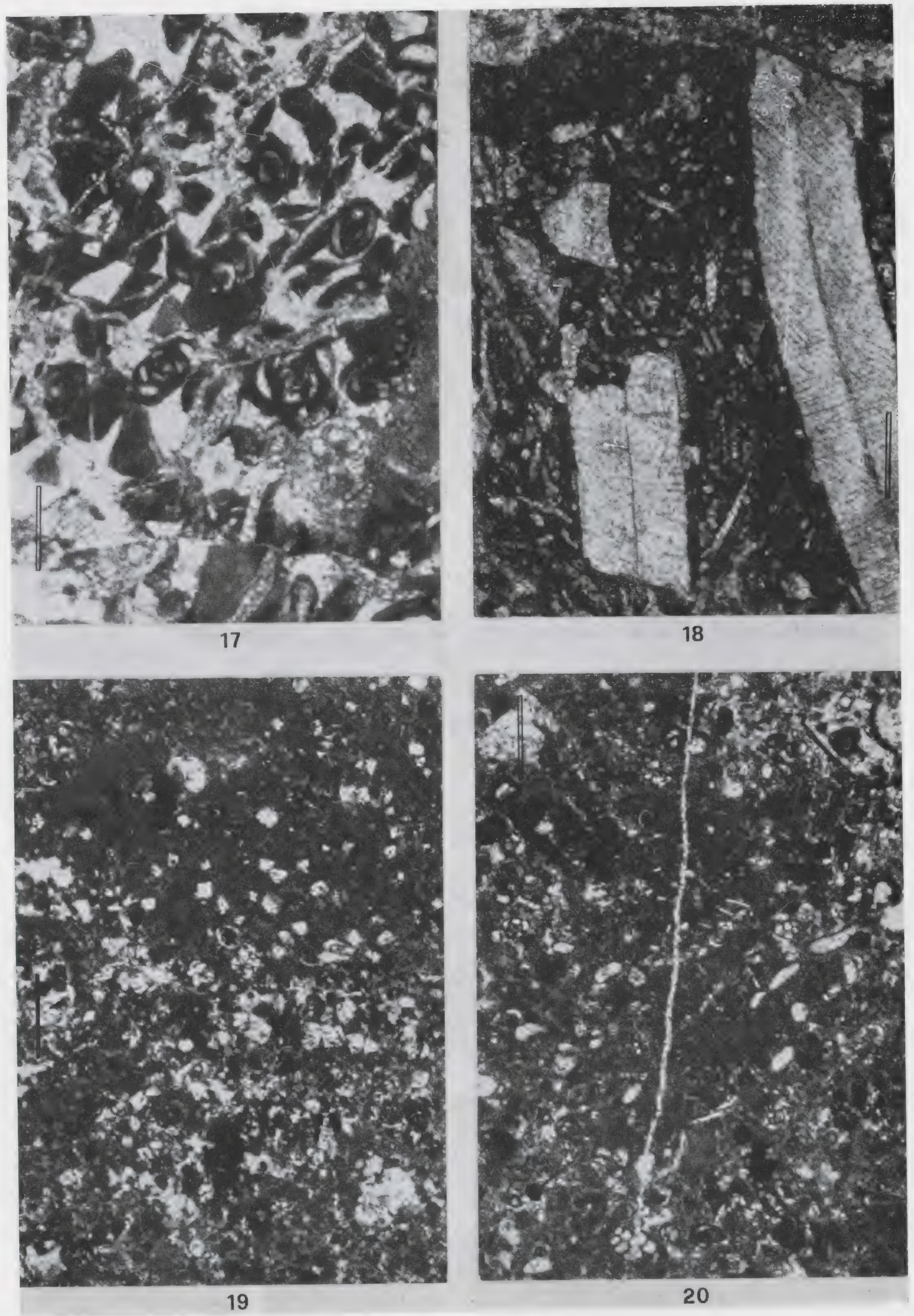


Fig. 53. - *17*) C 73 B 11: Sparite à Algues et Foraminifères, très cataclastique: ? (LPNA); *18*) C 73 B 10-2: Microsparite à débris de Rudistes: Crétacé? (LPNA); *19*) C 73 B 10-4: Dispelmicrite à rares Ostracodes et Foraminifères partiellement dolomitisée: ? (LPNA); *20*) C 73 B 10-3: Dismicrite à Algues et Ostracodes: Crétacé? (LPNA). Echelle: le trait représente 75 microns.

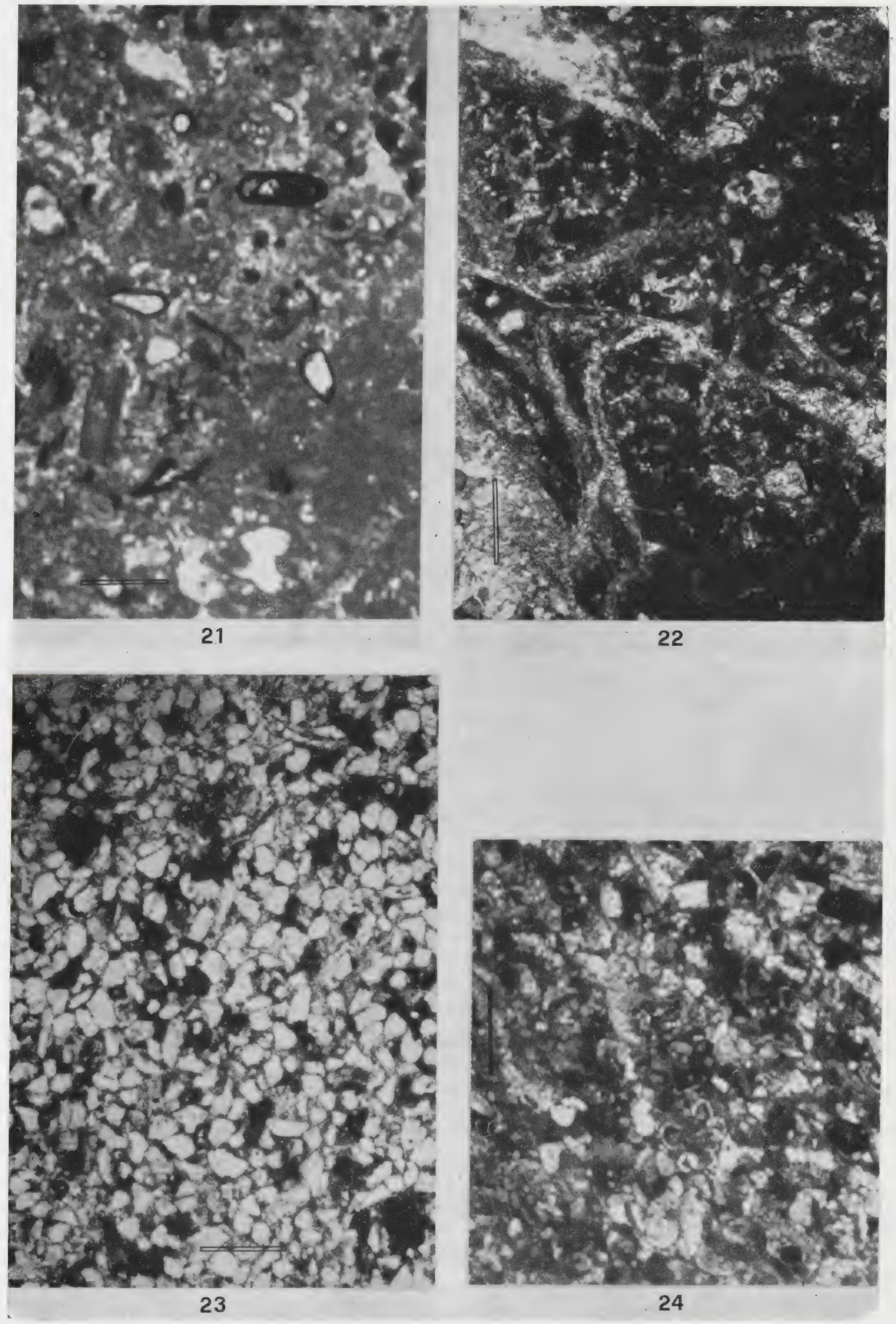


Fig. 54. - *21*) C 73-43: Dismicrite à rares Foraminifères et Algues, dolomitisée: ? (LPNA); *22*) C 73 B 15: Micrite et microsparite à Foraminifères et Pélécypodes, très cataclastique (pierre avec une lettre punique peinte): ?? (LPNA); *23*) C 73 B 5-2: Grès calcaire fin à débris charbonneux: Récent? (LPNA); *24*) C 71-7: Biosparite à quartz et Globigérinidés (panchina): Récent (LPNA). Echelle: le trait représente 75 microns

C 71–42 Terre cuite
C 71–43 Grès calcaire (n° SI 63–71): Récent
C 71–44 Alternance de laminites: pelmicrite et micrite à rares débris (Halobia possible) et Ostracodes, cataclasée: Trias
C 71–45 Dismicrite à Algues, Foraminifères, Ostracodes: ?
C 71–46 Calcaire à Foraminifères: Crétacé
C 71–47 Radiolarite, fines laminites à Radiolaires et spicules: Jurassique?
C 71–48 Gneiss (quartz, biotite, microcline): ??
C 71–49 Calcaire à Rudistes (n° Si 71–108): Crétacé
C 71–50 Biomicrosparite à Foraminifères (Miliolidés...): Crétacé
C 71–51 Brèche dolomitique: ??
C 71–52 Biopelmicrosparite à Foraminifères et Algues (n° Si 71–37): Crétacé?
C 71–53 Dolomie: ??
C 71–54 Grès calcaire: Récent
C 71–55 Grès calcaire: Récent
C 71–56 Biomicrite à Algues, Miliolidés, Ostracodes, Structure de type "bird's eye": ?

C 71–1: 71–56: Echantillons conservés à Marsala dont j'ai prélévé des fragments en 1973.

C 72–1 Quartz filonien transmis à Paris en fin 1973

C 73 B Echantillons

C 73 B 1: Sac marqué: «pierres typiques en contact avec la coque»

C 73 B 1–1 Granite à biotite et grenat: ?? (fig. 50 no. *5* et *6*)
C 73 B 1–2 Micaschiste (quartz, biotite chlorite): ?? (fig. 51 no. *9*)
C 73 B 1–3 Galet de quartz: ??
C 73 B 1–4 Gneiss (ou granite cataclasé) à sphène et grenat: ?? (fig. 50 no. *7*)
C 73 B 1–5 Micrite à Radiolaires et Nannoconus: Crétacé inf. (fig. 50 no. *12*)
C 73 B 1–6 Galet de quartz: ??
C 73 B 1–7 Gneiss oeillé: ?? (fig. 50 no. *8*)
C 73–B 1–8 Basalte à Olivine: ??
C 73 B 1–9 Basalte à Olivine: ??

C 73 B 2: Echantillon marqué: «from lead level»

C 73 B 2 Leucotéphrite: ??
C 73 B 2X Leucotéphrite: ??

C 73 B 3: Echantillon marqué: «Rock common at lead level under hull»

C 73 B 3 Grès calcaire à pigment ferrugineux et rares débris charbonneux: Récent

C 73 B 4: Echantillon marqué: «Si 3–73»

C 73 B 4 Grès calcaire à Foraminifères, Algues, Bryozoaires, Echinodermes et Lamellibranches: Miocène inf. ?

C 73 B 5: Echantillons marqués: «under hull (representative beach rock local)»

C 73 B 5–1 Grès calcaire à débris charbonneux: Récent?
C 73 B 5–2 Grès calcaire fin à débris charbonneux: Récent ? (fig. 54 no. *11*).

C 73 B 6: Echantillon marqué: «Si 24–73»

C 73 B 6 Micaschiste: ??

C 73 B 7: Echantillons marqués: «Si 8–73»

C 73 B 7–1 Chert à fantômes de Radiolaires: ??
C 73 B 7–2 Quartzarénite à ciment ferrugineux et débris d'Algues et de Lamellibranches: ??
C 73 B 7–3 Terre cuite

C 73 B 8: Echantillons marqués. «Si 29–73»

C 73 B 8–1 Galet de quartz: ??
C 73 B 8–2 Galet de quartz, un peu de muscovite (fragment de filon?): ??
C 73 B 8–3 Hyaloclastite: ?? (fig. 49 no. *3*)
C 73 B 8–4 Hyaloclastite: ??
C 73 B 8–5 Calcarénite: ??
C 73 B 8–6 Leucotéphrite: ?? (fig. 49 no. *1* et *2*)

C 73 B 9: Echantillons marqués: «13–8–73 PG Gviel 2»

C 73 B 9–1 Basalte à Olivine: ?? (fig. 49 no. *4*)
C 73 B 9–2 Basalte à Olivine: ??
C 73 B 9–3 Basalte à Olivine: ??

C 73 B 10: Echantillons marqués: «Stones stuck inside hull (with putty)»

C 73 B 10–1 Dismicrite et pelmicrite à rares débris d'Echinodermes, cataclasée (n° Si 6–73): ??
C 73 B 10–2 Microsparite à débris de Rudistes (n° Si 33–73): Crétacé? (fig. 53 no. *18*)
C 73 B 10–3 Dismicrite à Algues, Ostracodes, Foraminifères: Crétacé? (fig. 53 no. *20*)
C 73 B 10–4 Dispelmicrite à rares Miliolidés et Ostracodes, partiellement dolomitisée (n° Si 33–73): ? (fig. 53 no. *19*)

C 73 B 11: Echantillon marqué: «Si 30–73 with odd nails»

C 73 B 11 Sparite à Algues et Foraminifères, très cataclasée: ? (fig. 53 no. *17*)

C 73 B 12: Echantillons marqués: «quantitative sample ballast Grid 1–73»

C 73 B 12–1 Intrabiomicrosparite à Algues et Foraminifères: Crétacé
C 73 B 12–2 Miscrosparite à Ostracodes, Miliolidés, Globigérinidés, cataclasée: Crétacé-Eocène
C 73 B 12–3 Dismicrite à Ostracodes, rares Foraminifères, débris d'Algues:?
C 73 B 12–4 Microsparite à Algues et Foraminifères (Miliolidés, Flosculines): Eocène
C 73 B 12–5 Biointramicrite à nombreux débris d'Algues: ?
C 73 B 12–6 Micrite à Algues et Foraminifères, très cataclasée:?
C 73 B 12–7 Pelmicrite et dismicrite à rares Algues, cataclasées: ?
C 73 B 12–8 Brèche; galets de micrite à Foraminifères, partiellement dolomitisé: ?
C 73 B 12–9 Pelmicrosparite à rares Foraminifères et biolithite à Algues et Lamellibranches: Crétacé ?
C 73 B 12–10 Chert à Radiolaires et spicules: ?
C 73 B 12–11 Dismicrite à Ostracodes, rares Foraminifères, débris d'Algues, cataclasée: ?
C 73 B 12–12 Brèche tectonique de micrite à Foraminifères: ?
C 73 B 12–13 Divers faciès imbriqués: dismicrite, microsparite et pelmicrosparite à Foraminifères, Algues et Lamellibranches: Crétacé?
C 73 B 12–14 Dismicrite à Foraminifères et Algues: ?
C 73 B 12–15 Intrabiopelmicrite à Algues et Foraminifères: Crétacé (fig. 52 no. *16*)
C 73 B 12–16 Dismicrite à rares Foraminifères et Ostracodes: ?
C 73 B 12–17 Intrabiopelmicrite à Algues et Foraminifères: Crétacé ?
C 73 B 12–18 Intrabiopelmicrite à Algues et Foraminifères: Crétacé ?
C 73 B 12–19 Intrabiopelmicrite à Algues, Foraminifères et Lamellibranches, partiellement dolomitisé: Crétacé ?
C 73 B 12–20 Micrite à débris de Rudistes, très dolomitisé: Crétacé
C 73 B 12–21 Micrite et pelmicrite (rare) à rares Foraminifères et Ostracodes, cataclasée: ?
C 73 B 12–22 Micrite à rares Ostracodes, cataclasée: ?
C 73 B 12–23 Biointramicrite à Lamellibranches et Foraminifères (Miliolidés et Globigérinidés) cataclasée: Crétacé–Eocène.
C 73 B 12–24 Micrite à Foraminifères (Globigérinidés) et rares grains ferrugineux: ?
C 73 B 12–25 Pelsparite et pelmicrosparite à Foraminifères et Ostracodes: ?
C 73 B 12–26 Intrapelmicrosparite à Foraminifères, cataclasée: Crétacé
C 73 B 12–27 Dismicrite à Algues, Foraminifères et Lamellibranches: ?
C 73 B 12–28 Pelmicrosparite à Algues, Foraminifères et Lamellibranches: ?
C 73 B 12–29 Pelmicrite, pelmicrosparite et pelsparite à Algues et Foraminifères: ?
C 73 B 12–30 Dismicrite, pelmicrite et pelmicrosparite à Algues et Foraminifères: ?
C 73 B 12–31 Intrabiopelmicrite à Algues et Miliolidés: Crétacé

C 73 B 12–32 Dismicrite cataclasée: ?
C 73 B 12–33 Alternance de dismicrite à Miliolidés et de dismicrite à Ostracodes en laminites parallèles, dolomitisée: ?
C 73 B 12–34 Intrabiopelmicrosparite à Miliolidés, cataclasée: Crétacé
C 73 B 12–35 Dismicrite à Algues, bréchique et dolomitisée: ??
C 73 B 12–36 Pelmicrite à rares débris de Lamellibranches, cataclasée et légèrement dolomitisée: ??
C 73 B 12–37 Intrabiopelmicrosparite à Foraminifères: Crétacé
C 73 B 12–38 Grès calcaire fin à Foraminifères: Récent
C 73 B 12–39 Dismicrite et pelmicrite, nombreux stylolithes: ??
C 73 B 12–40 Dismicrite et pelmicrite, partiellement dolomitisée, cataclasée: ?
C 73 B 12–41 Pelmicrosparite à Algues, Foraminifères, Madréporaires: ?
C 73 B 12–42 Dismicrite à rares Foraminifères et Ostracodes: ?
C 73 B 12–43 Intrapelmicrite à Foraminifères et Algues, cataclasée: Crétacé
C 73 B 12–44 Intrabiomicrite à Foraminifères et Algues: Crétacé
C 73 B 12–45 Intrabiopelsparite et micrite à rares Foraminifères: ?
C 73 B 12–46 Laminites d'intrabiomicrosparite à Algues et Foraminifères: Crétacé
C 73 B 12–47 Brèches à galets crétacés et triasiques: ??
C 73 B 12–48 Grès calcaire à rares Foraminifères: ??
C 73 B 12–49 Micrite à Ostracodes, rares Foraminifères et Algues, cataclasée: ?
C 73 B 12–50 Dismicrite à rares Foraminifères, Algues et Ostracodes: ?
C 73 B 12–51 Phyllades (quartz, séricite): ??
C 73 B 12–51 à 73 B 63 Très petits galets calcaires non étudiés au microscope
C 73 B 12–64 Phyllade: ??
C 73 B 12–65 Basalte à Olivine: ??

C 73 B 13: Echantillons marqués: S 73/13

C 73 B 13–1 Pelintramicrite à Algues, Foraminifères, Aeolisaccus et dismicrite à Ostracodes: Lias
C 73 B 13–2 Brèche: galets de pelintramicrite à Algues et Foraminifères, de lutite à Radiolaires, de silex, de micrite à Calpionelles, de dolomie: ??
C 73 B 13–3 Intrasparudite à Foraminifères (Miliolidés) et galets dolomitiques: ??

C 73 B 14: Echantillons marqués: « Paolo Giacalone 13–8–73 »

C 73 B 14–1 Intrabiomicrosparite à Algues et Foraminifères: ?
C 73 B 14–2 Intrabiopelmicrite à Echinodermes, Algues et Foraminifères: ?
C 73 B 14–3 Intrabiopelmicrosparite à Algues et Foraminifères, très dolomitisée: Crétacé
C 73 B 14–4 Intrabiopelmicrosparite à Algues et Foraminifères (Miliolidés) et Ostracodes: Crétacé.
C 73 B 14–5 Pelmicrite à Foraminifères, Algues et Echinodermes et dismicrite: Lias?
C 73 B 14–6 Micrite à spicules, Ostracodes, rares Echinodermes: Jurassique moyen?
C 73 B 14–7 Pelmicrosparite à Foraminifère et Algues, cataclasée: ?
C 73 B 14–8 Pelintramicrosparite à Foraminifères (Miliolidés, Cunéolines), Algues et Ostracodes: Crétacé
C 73 B 14–9 Pelintramicrosparite à Algues (Thaumatoporella), Foraminifères, Aeolisaccus: Lias?
C 73 B 14–10 Pelintramicrosparite à Foraminifères (Miliolidés), Algues, Ostracodes: Crétacé
C 73 B 14–11 Pelintramicrosparite à Ostracodes et rares Foraminifères: ?
C 73 B 14–12 Pelmicrite à Foraminifères, Lamellibranches, très dolomitisée, cataclasée: ??
C 73 B 14–13 Micrite à Ostracodes et rares Foraminifères et dispelmicrite, cataclasée: ?
C 73 B 14–14 Micrite à Ostracodes, dolomitisée, cataclasée: ??
C 73 B 14–15 Pelsparite à Ostracodes et rares Foraminifères, partiellement dolomitisée: ??
C 73 B 14–16 Nombreux faciès imbriqués: pelsparite, pelmicrite, dismicrite à Ostracodes: ?
C 73 B 14–17 Dismicrite et pelsparite à Algues, Aeolisaccus, Foraminifères (Miliolidés, Lituolidés) peu de dolomite, perforations de Litophages: Lias
C 73 B 14–18 Intrabiopelsparite à Foraminifères et Algues, joints de tension de calcite: ??
C 73 B 14–19 Intrabiopelmicrosparite à Ostracodes et Foraminifères: ?
C 73 B 14–20 Intrabiopelmicrosparite à Foraminifères, Algues, Lamellibranches: Crétacé
C 73 B 14–21 Micrite à débris (Foraminifères, Algues, Lamellibranches): ?
C 73 B 14–22 Micrite à Algues, Foraminifères et Rudistes: Crétacé
C 73 B 14–23 Dismicrosparite à Algues et Ostracodes: ?
C 73 B 14–24 Micrite à débris (Foraminifères et Lamellibranches) très dolomitisée: ??
C 73 B 14–25 Micrite à débris (Algues et Foraminifères) partiellement dolomitisée: ??

C 73 B 14–26 Dismicrite et pelsparite à Algues et Foraminifères: ?
C 73 B 14–27 Micrite très dolomitisée: ??
C 73 B 14–28 Dismicrite et pelsparite à Algues et Foraminifères: ?
C 73 B 14–29 Micrite à Ostracodes et pelmicrite, cataclasée: ??
C 73 B 41–30 Brèche dolomitique: ??
C 73 B 14–31 Alternance de laminites de micrite à Ostracodes et de pelmicrosparite, perforations de Lithophages: ?
C 73 B 14–32 Micrite à Algues, Foraminifères et Ostracodes et pelsparite partiellement dolomitisée, perforations de Lithophages: ?
C 73 B 14–33 Microsparite à Algues et Foraminifères (Miliolidés, Alvéolinidés), joints de tension: Crétacé.
C 73 B 14–35 Brèche à galets de silex, de pelsparite liasique, de dolomie, débris de Rudiste , de grès calcaire: ??
C 73 B 14–36 Micrite à rares Foraminifères et Ostracodes, joints de tension: ?
C 73 B 14–37 Pelmicrosparite à rares Algues, partiellement dolomitisée très cataclasée: ?
C 73 B 14–38 Micrite à rares Foraminifères et pelmicrosparite: ?
C 73 B 14–39 Micrite très dolomitisée: ??
C 73 B 14–40 Schiste chloriteux: ??
C 73 B 14–41 Hyaloclastite: ??
C 73 B 14–42 à 53. Très petits galets calcaires non étudiés au microscope.
C 73 B 14–54 Grès calcaire: Récent
C 73 B 14–45 Grès calcaire: Récent
C 73 B 14-56 Hyaloclastite: ??

C 73 B 15: Pierre avec une lettre punique peinte

C 73 B 15 Micrite et microsparite à Foraminifères et Lamellibranches, très cataclasée et recristallisée: ?? (fig. 54 no. *22*).

Echantillons récoltés en ma présence en Aout 1973

C 73–6 Intrasparite à Algues (Lithothamniées), Bryozoaires, Foraminifères, Echinodermes, Gastéropodes: ??
C 73–7 Pelsparite et pelmicrosparite à Algues et Foraminifères (Miliolidés, Cunéolines, Dicyclines): Crétacé
C 73–8 Biointrasparite: Récent
C 73–9 Micrite à Echinodermes et Rudistes: Crétacé?
C 73–11 Intrabiopelsparite à Foraminifères et croûte stalagmitique: ??
C 73–12 Pelmicrite à Algues (Thaumatoporella) et Foraminifères, très dolomitisé: Lias?
C 73–13 Intraoosparite à Algues (Lithothamminiées), Bryozoaires, Foraminifères et Echinodermes: ??
C 73–15 B 1 Micaschiste: ??
C 73–15 B 2 Micaschiste: ??
C 73–16 Dismicrite à rares Foraminifères: ?
C 73–20 A 1 Micrite siliceuse à fantômes de Globigérinidés et spicules: Eocène?
C 73–20 A 2 Pelsparite à Foraminifères, Aeolisaccus: Lias
C 73–20 B 1 Micrite à Algues partiellement siliceuse: ??
C 73–20 B 2 Grès calcaire glauconieux: Miocène inf.
C 72–20 B 3 Grès calcaire glauconieux: Miocène inf.
C 73–20 B 4 Dismicrite à Ostracodes, silicifiée: ??
C 73–20 B 5 Micrite à Radiolaires, Ostracodes et Spatangides: Crétacé inf. ?
C 72–30 B 6 Micrite siliceuse à Radiolaires et spicules: ??
C 73–20 B 7 Silex avec joints de tension calcitiques: ??
C 73–20 B 8 Grès calcaire ferrugineux, joints de tension calcitiques: Miocène inf. ?
C 73–20 B 9 Silex avec fantômes de Radiolaires, joints de tension calcitiques: ??
C 73–20 C 1 Micrite à Radiolaires, rares Foraminifères, Ostracodes, Lamellibranches: Crétacé.
C 73–20 C 2 Micrite à Radiolaires, rares Foraminifères, Ostracodes, rares Calpionelles: Crétacé inf.
C 73–20 C 3 Micrite à débris de Calpionelles: Crétacé inf.
C 73–20 C 4 Intrapelmicrite à Calpionelles, Echinodermes, Rudistes et galets à Calpionelles: Crétacé inf.
C 73–20 C 5 Micrite à Radiolaires siliceux et spicules disposés tous parallèlement: Crétacé inf. ?
C 73–20 C 6 Micrite à Radiolaires, Globigérinidés et spicules: Crétacé inf.
C 73–20 C 7 Grès calcaires et ferrugineux à glauconite: Miocène inf. ?

C 73-20 C 8 Brèches à Orbitoïdidés et galets de micrite à Calpionelles et de pelsparite: Crétacé
C 73-20 C 9 Micrite et microsparite à Radiolaires joints de tension de calcite: ??
C 73-20 C 10 Micrite à Radiolaires et Calpionelles: Crétacé inf.
C 73-22 Micrite à débris de Rudistes, dolomitisée: Crétacé inf. ?
C 73-24 Biomicrite à rares Echinodermes, Algues, Rudistes, Foraminifères (Orbitoïdidés, Miliolidés): Crétacé
C 73-25 Biomicrite à Echinodermes, Madréporaires, *Vidalina*, galets de biopelsparite: Lias
C 73-26 Micrite et microsparite à Algues, Foraminifères, pellets, zones de dismicrite, très cataclasée: Lias
C 73-34 Microsparite à Foraminifères (Miliolidés, Cunéolines), Lamellibranches, Ostracodes, Algues, rares pellets, très cataclasée: Crétacé (fig. 52 no. *14*).
C 73-37 Dismicrite et pelmicrosparite à rares Foraminifères et Ostracodes: ?
C 73-38 Pelmicrite à Ostracodes et filaments onduleux (Halobia ?): Trias ?
C 73-39 Grès calcaires à Echinodermes, Lamellibranches, Algues (Lithothammiées), Bryozoaires et Foraminifères (Miogypsinidés): Miocène inf.
C 73-40 Pelmicrite à rares Ostracodes, Foraminifères et structure du type "bird's eye": Crétacé ?
C 73-41 Micrite à rares débris de Foraminifères et d'Ostracodes, cataclasée: ??
C 73-42 Dismicrite à rares Foraminifères et Algues, dolomitisée: ?
C 73-43 Dismicrite à rares Foraminifères et Algues, dolomitisée: ? (fig. 54 no. *21*).
C 73-44 Dolmicrite à structure sphériques énigmatiques: ??
C 73-45 Dismicrite à rares Algues et Foraminifères, dolomitisée: ?
C 73-46 Micrite à Ostracodes et rares Foraminifères et pelmicrosparite à Foraminifères: ?
C 73-47 Micrite à Ostracodes et dismicrite: ??
C 73-48 Micrite à débris de Rudistes, dolomitisée: Crétacé?
C 73-49 Pelmicrite à filaments onduleux (Halobia?): Trias?
C 73-50 Dismicrite à nuclei algaires: ??
C 73-51 Micrite et microsparite à Algues, Lamellibranches, Ostracodes, partiellement dolomitisée: ?
C 73-52 Dolomicrite à fantômes de fossiles (Radiolaires?): ??
C 73-53 Brèche à galets dolomitiques: ??
C 73-54 Sparite à oncolithes et Foraminifères: Crétacé
C 73-55 Micrite à rares Habolia et Radiolaires, très cataclasée: Trias (fig. 51 no. *10*).
C 73-56 Brèche dolomitique: ??
C 73-57 Biomicrite à Echinodermes, algues, Rudistes, Foraminifères: Crétacé

Echantillons étudiés par G. Vianelli

Si 1-74 Granite porphyroïde à tendance pegmatitique: quartz, feldspaths (orthose, microlines, biotite chloritisée). L'origine n'est pas la Sicile, peut être la Sardaigne ou la Grèce.
Si 2-3-74 Basaltes porphyriques très proches de ceux de l'Etna ou de Pantelleria

L'Examen des faciès

L'examen des faciès montre donc la répartition suivante:

85% de roches sédimentaires;
15% de roches cristallines (éruptives et métamorphiques).

Les proportions respectives deviennent 93% et 7% si l'on peut considérer quartz, gneiss et schistes commes des galets, les 7% restant étant formés de roches volcaniques.

Le soubassement local est représenté par 5% des échantillons, valeur qui inclut les fragments de terre cuite, ce qui indique une contamination relativement faible.

– Parmi les roches sédimentaires le Crétacé représente 17,5% du total, très vraisemblablement (Crétacé + Crétacé ?) 24% du total et probablement 49% du total (Crétacé + Crétacé ?+?).

Les faciès du Crétacé (Crétacé + Crétacé?) sont à 78% des faciès récifaux ou périrécifaux. De tels faciès existent dans tout le domaine méditerranéen (fig. 55) tels l'ancienne Phénicie, Chypre, la Crète et la Grèce continentale (faciès du Gavrovo – Tripolitsa et d'Apulie), la Cyrénaique (région de Derna), la Sicile (faciès panormide et région ibléenne), l'île de Zembra (au large de Tunis), les Pouilles et la Campanie–Lucanie la Sardaigne (Alghero, Oliena, San Antioco), la Provence occidentale, la chaîne ibérique, le Portugal et même la région de Constantine en Algérie (mais dans ce dernier cas les affleurements sont situés relativement loin de la mer).

Les autres faciès identifiés se répartissent comme suit:

– Lias pelsparitique 4,5%; grès calcaires du Miocène inférieur 2,5%; Trias marin 1,5%; Eocène surtout pélagique 1,5%; Jurassique moyen pélagique près de 1% (certains faciès siliceux, radiolarites et cherts pourraient en faire partie).

– Leur signification est variable, le Lias pelsparitique est pratiquement ubiquiste en Méditerranée de Gibraltar à la Phénicie. Le Miocène inférieur gréso-calcaire est également assez répandu. Le Trias à faciès alpin est cantonné à la Méditerranée orientale (Grèce–Chypre–Turquie) et à la Sicile et l'Apennin (fig. 55). Le Jurassique moyen pélagique et l'Eocène pélagique sont ubiquistes mais affleurent peu.

Parmi les faciès sédimentaires non datés (??), et mis à part les silex qui pourraient être jurasiques, il n'apparait pas de faciès remarquable. En fait la nondatation est due au fait qu'ils s'agit de brèches ou de faciès dolomitisés, voire de brèches dolomitiques. De tels faciès existent un peu partout en Méditerranée.

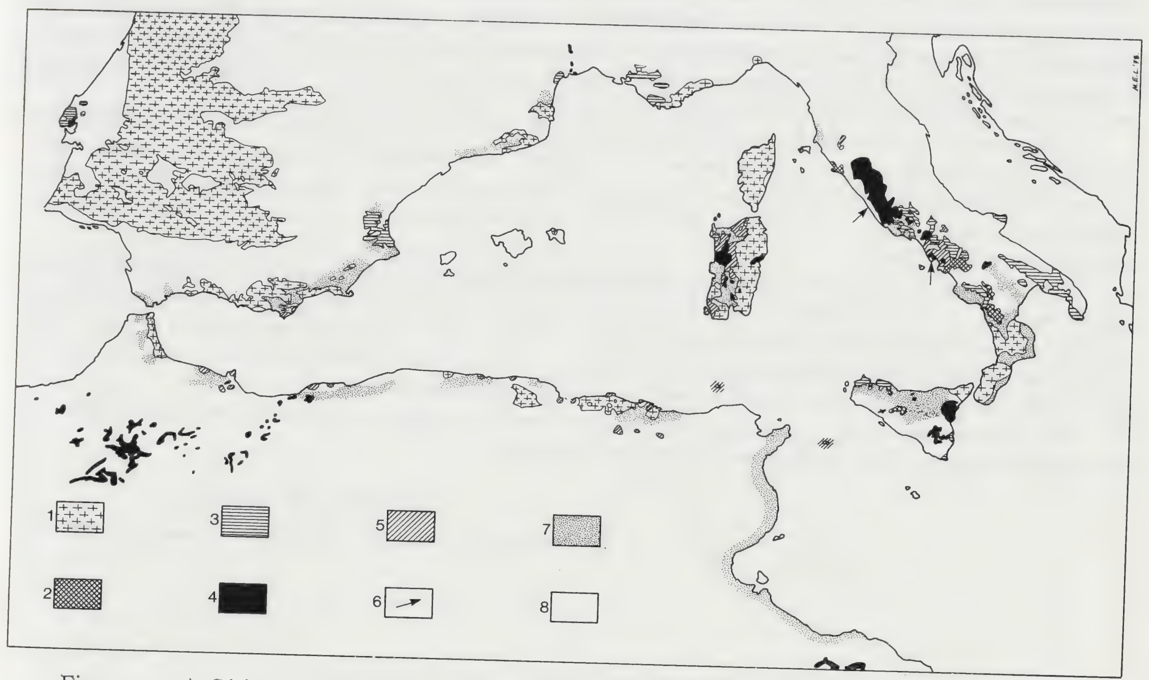


Fig. 55. – 1) Séries cristallines; 2) Trias alpin; 3) Crétacé récifal; 4) Volcanisme alcalin; 5) Volcanisme acide; 6) Téphrites à leucite; 7) Conglomérats à galets cristalin; 8) Gites Pb.

Parmi les roches cristalline et cristallophylliennes nous distinguerons les roches volcaniques (7%) des autres (8%). Ces dernières, un granite probable et des gneiss, micaschistes, schistes et des quartz filoniens, peuvent provenir des formations conglomératiques de l'Oligocène – Miocène inférieur ou du Tortonien toujours riches en galets cristallins. C'est pourquoi sur la figure ont été portés soit les domaines cristallins (Alanya et Mendérès en Turquie, Attique–Cyclade en Grèce, massif Calabro-péloritain en Italie, massif corso–sarde, Maures et Tanneron, Pyrénées et massif catalan, Meseta ibérique, massif bétique, massif rifain, Kabylies et Edough) mais aussi, les principaux domaines ou des conglomérats peuvent avoir fourni de tels éléments; on voit qu'ils sont abondamment représentés partout en Méditerranée.

Les roches volcaniques appartiennent à trois groupes: les hyaloclastites, les basaltes à Olivine, les leucotéphrites. Les hyaloclastites, tufs et tephra apparaissent en liaison avec tous les appareils volcaniques qu'ils soient à tendance acide ou alcaline et donc existent un peu partout en Méditerranée. Les basaltes à Olivine sont relativement communs et sont connus au moyen Orient et en Libye, encore qu'assez éloignés de la mer; en Oranie certains massifs sont proches de la mer, de même au Portugal, en Sardaigne et en Italie ainsi qu'en Languedoc. A cela il faut ajouter Pantelleria (partie nord–ouest de l'île) et Linosa. Ces basaltes a Olivine sont des plus banals et ne présentent pas de ressemblance avec des faciès particuliers comme ceux d'Alboran, de l'Etna, du Volcanisme ibléen. De même on notera l'absence de roches assez typiques comme des obsidiennes ou certains faciès plus acides de Pantelleria. Un seul fragment de ponce a été rencontré; sa signification est

nulle dans la mesure où de nos jours les courants emportent des fragments depuis Lipari jusque sur toutes les côtes du bassin occidental.

Les téphrites à Leucite sont par contre extrêmement caractéristiques; elles, ne peuvent provenir que des régions de Rome et de Naples (fig. 55). Deux échantillons différents appartiennent à ce type (73 B 2 et 73 B 8-6) Il y a peu de chances pour qu'ils soient dus à une pollution extérieure, qu'on ne s'expliquerait pas à cet endroit, à moins de mélange entre lest de différents navires coulés.

Dans ces conditions deux possibilités s'offrent à nous. 1: L'ensemble des roches est représentatif du domaine où a été construit le navire et celui-ci provient de chantiers proches de Rome ou de Naples. 2: Ou bien certains des galets ont été réemployés. Dans les chantiers navals il n'est pas rare que voisinent des coques en construction et de vieilles coques abandonnées. Et le lest de vieilles coques peut être ainsi réemployé. Ceci signifie alors que tous les galets ne sont pas représentatifs de la région où se situait le chantier naval.

Les roches elles-mêmes ne permettent pas de choisir entre les deux hypothèses. Tous les faciès rencontrés sont en effet compatibles avec les régions de Rome et Naples.

Si l'ensemble des roches n'est pas représentatif de la région du chantier naval; certaines d'entre elles telles les leucotéphrites ont pu être importées. En toute rigueur il est nécessaire de se demander si tous les faciès ne proviennent pas d'importation et il est bien certain que quelle que soit la région qui apparaîtra comme origine possible du navire au terme de cette étude, il restera un doute.

On peut penser que les faciès les plus abondants sont ceux qui ont le plus de chance de représenter la région. Il en résulte que celle-ci doit se trouver à proximité d'affleurements de Crétacé à faciès récifal. Nous avons vu plus haut quelles sont les régions où existent ces faciès. Si l'on tient compte des autres faciès à l'exclusion des roches volcaniques, le choix se restreint à l'ancienne Phénicie et aux monde grec d'une part et à la Sicile occidentale de l'autre.

En particulier tous les faciès sédimentaires existent dans les monts de Trapani et sont largement remaniés à l'état de galets le long des plages de San Vito lo Capo jusqu'au Capo Granitola. Les galets cristallins ne sont pas rares, ils proviennent des conglomérats tortoniens et aussi du lest des barges qui viennent charger le sel, et l'on trouve ainsi actuellement des fragments de lave de l'Etna. Les basaltes à Olivine et les leucotéphrites sont obligatoirement importés; les premiers peuvent venir de Pantelleria ou de Linosa.

Dans ces conditions l'un quelconque des établissements carthaginois du Nord Ouest Sicilien peut être à l'origine du navire: Palerme, Solunto, Trapani, ou Marsala.

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" THE REGION OF ROME ": A POSSIBILITY

The one possibility that requires further comment is M. Mascle's observation that if the ballast is to be considered as a whole, then it could only have come from either the region of Rome or of Naples. On historical grounds both appear unlikely; no evidence should, however, be dismissed without any pause for thought. The Etruscan city states on the coast near Rome had long been allied with Carthage, but by the beginning of the 3rd century B. C. they had been subjugated either by force or by treaty. Nevertheless Caere, for instance, rebelled as late as 278 B. C. and had ceded only half its territory by 205 B. C.

Recent archaeological evidence is beginning to suggest that the end of the Punico-Etruscan connexion might not have been as clear-cut as history books have hitherto lead us to believe. Punic coins have been found among other votive offerings in a 3rd century level of excavation in an Etruscan temple (2). Colozier points out the importance to the Romans of coastal defence: at the beginning of the First Punic War in 264 B. C., they had to protect their own shipping and to prevent enemy use of the coast in a " territory just subdued

(2) I am indebted to Dott. Gianfrotta for pointing this out to me. P. A. GIANFROTTA, *Castrum Novum*, Forma Italiae, Regio viii, 3, Rome 1972, p. 118.

and traditionally allied with the Carthaginians " ... " certainly the process of Romanization of coastal Etruria, at least for some cities, was slow " (3). The coast was noted for its shipyards: during the second punic War, after Publius Cornelius Scipio " Africanus " had conquered in Spain and was preparing to attack Carthage, Livy tells us that he built his fleet in Etruria, getting sail-cloth from Tarquinii, grain and ship's fittings from Rusellae, iron from Populonia, arms from Arretium etc. By this time it is unlikely that the Etruscans were selling arms to his opponents, or that Punic ships still made use of the coastal facilities, but evidence of the old alliance still persists in the form of a funerary inscription from Tarquinia, in Etruscan, to a soldier who fought with Hannibal (4).

None of this would be worth mentioning, were we concerned with either a very large merchant ship or a quinquireme, the building of which would have required a stable background and the facilities of a large shipyard. The Marsala Punic Ship is, however, fairly small as well as being made to a predetermined pattern, from imported woods... indeed possibly from imported prefabricated parts too. Consequently, given skilled labour, it could have been assembled quickly and almost anywhere.

HONOR FROST

(3) E. COLOZIER, *Mél.*, LXV, Rome 1953, pp. 16 and 63.
(4) A. J. PFIFFIG, in *Studi Etruschi* XXXV, 1967, pp. 659-663.

X. METALS

Introduction

Metals in the structure and accoutrement of ancient ships (as distinct from their cargoes) are bronze or copper, iron and lead. Depending on period and provenance, they may be used as follows:

Bronze: nails joining the planking to the skeletal timbers below the waterline, and tacks attaching lead sheeting to the outside of the hull.

Iron: nails either above the waterline or otherwise not in direct contact with seawater; also tools such as hammers, adzes knives etc.

Lead: in sheet form, either attached to the hull to protect it from xylophagous molluscs, or carried inside it for repair purposes; brailing and other kinds of rings, either from the sails, or from stock of spares; plumbing appurtenances; fishing tackle, sounds, counterweights of various kinds; the lead stocks and other components from wooden anchors.

Any scrap of metal from a wreck should be as significant to ship archaeologists as potsherds are to archaeologists on land. I will therefore discuss each of the above metals as it applies to the Punic Ship. That I am able to cite metallurgical findings, is thanks to the generous collaboration of the Laboratories mentioned in the text and the acknowledgements. Further, in compiling this section I am deeply indebted to Mr. Leo Biek (Ancient Monuments Laboratory, Department of the Environment) for his help and advice; if errors remain in the following text, they are entirely mine.

Comparisons are few because as yet publications are both scarce and often equivocal. On the Grand Congloué wreck, for instance, all the nails are said to be of pure copper (1), but can this statement still be accepted in the light of Mr. G. C. Jones' findings given below? Further, considering that the Congloué was one of the first ancient wrecks to be discovered, and that no archaeologists worked on it underwater can it be accepted that there were no remains of iron corrosion products on the site ? and that the only nails were those inside the wood that was brought up for M. Benoit's inspection? Finally, recent results should not be compared without caution with those obtained only a few years ago (underwater excavation techniques having improved so that they are now equivalent to those used on land).

On a wreck, objects like nails may retain their general shape, but not their substance; hence the controversy about copper v bronze recounted below. Alternatively, as is the case with iron, the metal may " disappear " altogether, leaving a void in the shape of the original object in the centre of a stone-like concretion. This statement is an over simplification, for there are innumerable variations between the forms of metal corrosion products

(1) F. Benoit, *L'Epave du Grand Congloué*, in *Gallia* Supplement XIV, Paris 1961, p. 191 ff.

and concretions found on a single Mediterranean wreck, though even the varieties familiar to most experienced divers have not yet been adequately recorded and published. Possibly some of our findings may be modified in the light of future research, while others such as the work on lead isotopic ratios (which is still in progress) may not fully be interpreted

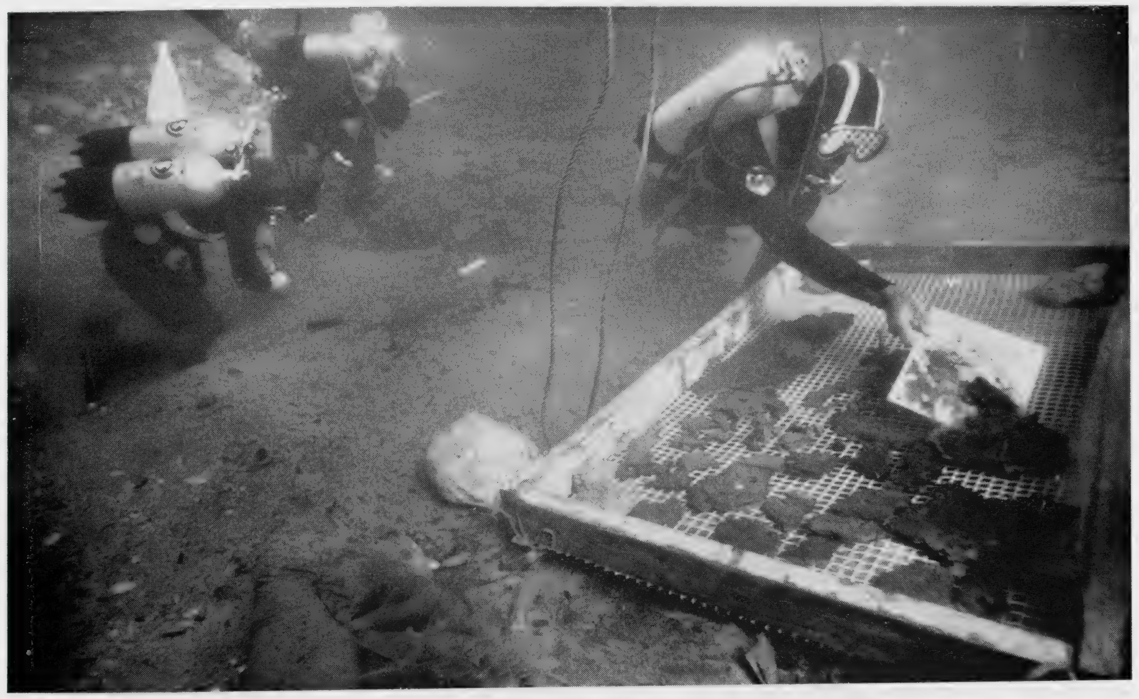


Fig. 56. – Collecting the powdery remains of the lead sheating after the hull had been raised.
Photo by J. Blair, National Geographic Society, U.S.A.

until more ancient lead mines have been located on land. However this may be, it is henceforth essential to publish all available analyses if only in order to build up a *corpus* of information for future studies.

1. *Bronze*

On the Punic Ship, the nails joining the planking to the timbers, as well as the tacks that attached the lead sheeting to the outside of the hull, were of bronze not copper. Whether this result is important or not, it certainly took no less than 5 years and 17 tests in three different laboratories before it could be established beyond reasonable doubt. As will be seen, the doubt had sprung from the fact that much bronze from the sea (and certainly bronze found in the conditions described on this site) tends to survive as a corrosion product rather than as solid metal. The sequence of the tests was as follows (the italics are mine).

In 1972 the first of the copper tacks (SI/3/71) was examined in the British Museum Research Laboratory, by emission spectrography; the verdict at that time was: " copper *not bronze*, the corrosion product contained a detectable amount of silver, but not tin " (R. L. File No. 2504, 18 May '72).

The following year a sample from the centre of one of the long nails (SI/219/72) was examined in the same laboratory by X-ray diffraction analysis, showing that " mineralization had produced copper sulphide and therefore the nail was originally *copper or bronze*.

Physical examination of the other nails in this sample confirms that they are similar " (R. L. Files Nos. 3106 and 2504).

Dr. C. V. Waine, working on a sample from the Punic Ship in the University of Aston's Metallurgy Department, came to a similar conclusion:

« I looked at the tack on the stereoscan probe analyser with the following results: copper present; zinc, none detected (i. e. less that 1/3 %); lead, present, also silicon probably sand. The tack seems to be dominantly a combination of sulphide and sulphate. I would have expected to detect some traces of tin and zinc *if the tack had not been originally copper.*» (personally communicated 9 Jan. '75). The specimen had been requested by Dr. Waine for his research on the dating of metals. Later a chance conversation about the copper and bronze problem had prompted him to examine it from this point of view.

It was in 1972 that three nails first reached Mr. G. C. Jones in the Department of Mineralogy in the British Museum of Natural History (BMNH). The Department's Keeper, Dr. A. C. Bishop originally agreed to identify some ballast stones. After one of them had been sectioned, Mr. A. R. Woollet (of the same Department) noticed a tack embedded in the putty adhering to the stone (see p. 122). He suggested a new approach to the copper and bronze problem; Dr. Oddy agreed, and Mr. G.C. Jones received the first nails from the Punic Ship. The latter's report of 28 May '74 states:

« Samples of about 2–5 mg of the completely corroded specimens were taken for qualitative spectrographic examination using a large Hilger quartz spectrograph for the wavelength range 2450–3500 Å.
Large " loose " nail '73: Elements: Major Cu, Minor Sb, As, Ni, Trace Mg, Fe, Pb.
Nail from " V 16, 1972 ": Major Cu, Minor Si, Sb, Pb, Ni, Trace Mg, Sn, Fe.
2nd " loose " Nail '73: Major Cu, Minor Sb, Ni, Trace Mg, Pb, Fe.
Zn not detected in any specimen. »

As a comparison for these Punic nails, I was able to give him one from the keel of the Grand Congloué Wreck.

He subjected it to the same form of examination:

« *Congloué Nail*, Elements: Major Cu, also present Pb, Sn, Sb, Ni, but in smaller amounts than in the nails from the Punic Ship.

There is a similarity between the Grand Congloué and the Punic Ship nails; the main difference between the two is the greater concentration of Pb, Sn, Sb, and Ni in the Punic Ship nails. »

Mr. Jones ended this first repoert, 28 May '74 with the words:

« The original nails seem to have been *made of copper*, other elements being present in insufficient amounts to be alloying elements .»

But none of these first samples had contained residual metal; Mr. Jones changed his mind the following year after analysing a nail from the newly discovered " Sister Ship " (fig. 57).

This nail, exceptionally, had a solid metal core, though that core was encased by the inevitable layers of corrosions products. Seizing his chance, Mr. Jones analysed not only the metal, but also two of its decayed outer layers.

In layman's terms: he discovered that though there was sufficient tin in the *metal* for it to be called bronze, this tin must have ' weathered ' badly, because it had almost vanished from the outer layers of the corrosion product.

The observation was of key importance, suggesting as it did that the Punic Ship nails might also be bronze; this was subsequently confirmed (see below). It also suggests that identifications from other wrecks might err for the same reason.

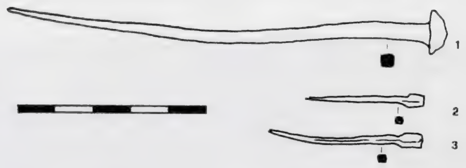


Fig. 57. - Sister ship: 1) nail SS/13/74; 2-3) headless tacks or "brads" SS/14a & b/74 (1 : 2).

The three analyses of the Sister Ship's nail obtained by atomic absorption spectroscopy, using solutions prepared from 10 mg of metal in each case, are as follows:

(SS/13/74) Metal: Cu 84.7 %, Pb 7.3 %, Sn 7.7 %, Zn 0.2 % *plus traces of Fe, Sb, Ag. Ni, Mg.*

Corrosion products nearest to metal: *Major Cu*, Minor Sn + Pb, Trace Fe, Zn, Sb, Ag, Ni, Mg, Mn, Ca, Si.

Corrosion products near external surface: *Major Cu*, Minor Si, Trace Pb, Fe, Ag, Mg.

Mr. Jones comments: «Careful examination of the corrosion product layers surrounding the bronze core of the Sister Ship large nail has shown that, in the conditions pertaining on this site, *tin is readily removed during the corrosion process*, consequently such corrosion products cannot be relied on to identify the original material. The First Report (May 28, '74) on the Punic Ship nails, must therefore be revised and all the reports that the nails were originally copper must be altered to 'copper or bronze.»

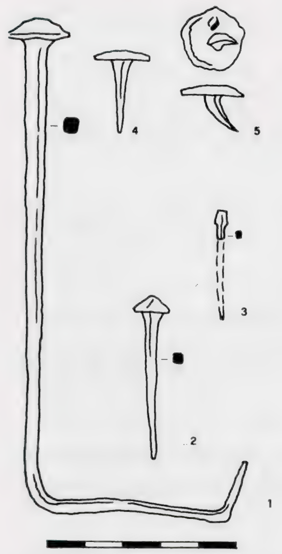


Fig. 58. - Punic Ship: 1) clinched nail SI/32/73; 2) SI/74-5; 3) headless tack or "brad" SI/325/74; 4) & 5) tacks from lead sheathing (1 : 2).

He added that because of the time involved in these tests, and because no reliable conclusions as to the nature of the original substance could be made, he was not prepared to undertake similar work unless residual metal was available for examination.

The preferential attack on the tin rich areas, under anaerobic conditions, has been noted in other submarine contexts. Again, I am deeply indebted to Mr. Leo Biek for pointing this out to me and to Mr. H. S. Campbell (British Non-Ferrous Metals Research Centre) for personally communicating the following observation: «in bronze, and in the presence of sulphide in seawater, the removal of tin from the scene could be explained by postulating a high enough solubility of tin sulphide due to local concentrations of hydrochloric acid formed electrolytically.»

But to revert to the Punic Ship; its nails would have been left in doubt had not merciful Providence in the person of my colleague John Wood, found a metal nail from the Punic Ship while he was classifying the representative shapes for drawing (fig. 58).

After examining the metal of this nail. Mr. Jones made his third and final report (of June 19, 1975):

«(SI/75): Copper 80.0 %, lead 12.3 %, Tin 7.1 %, Zinc 0.6 % (results rounded to the nearest 0.1 %, Tin is ± 0.5 %).

The composition of this alloy seems to fit the previous three nails from the Punic Ship (i.e. the two "loose" nails and the nail from V 16, quoted above p. 121, so they too can safely be called 'bronze')» (2).

Having explained how it was eventually established that representative nails from both ships were made of bronze not copper, I revert to Mr. Jones' remaining analyses in his Report No. 2 (all now be considered as bronze):

Punic Ship brad or 'headless' tack (SI/352/74): no metal detected, copper corrosion products. Major elements: Cu; Taces Sn, Pb, Fe, Si, Zn, Ni, Ag, Mg, Al.

Sister Ship 2 nail frags. (SS/14 a and b/74): no metal, copper corrosion products. Major elements: Cu; Minor Sn, low Pb, Trace Fe, Si, Zn, Ag, Mg, in addition one nail had traces Sb, the other Mn, Ca, Al.

Sister Ship 2 'headless' tacks (SS/14 a and b/74) Metal and copper corrosion products:

the shorter:

Cu 80.9 %, Pb. 10.7 %, Sn 9.4 %, Zn 0.3 %, As < 0.05 %.

the longer:

Cu 73.6 %, Pb 17.3 %, Sn 7.3 %, Zn 0.4 %, As < 0.05 %.

Bronze sheeting, Ram, Sister Ship (SS/10/74): no metal present, copper corrosion products.

N. B. Corrosion products: elements above + traces Fe, Si, Ag, Mg, Sb. Major element Cu; Minor: Sn, Traces: Pb, Fe, Si, Zn, Ag, Mn, Mg, Ca, Al. The tack frags: no metal present, copper corrosion products the composition similar to the sheathing corrosion product; both sheathing and tacks were probably bronze.

A Metallurgical Examination of two Nails from the Sister Ship

Dr. R. F. Tylecote (Department of Metallurgy, University of Newcastle upon Tyne) examined the two bronze nails from a different standpoint (fig. 59). Having cut small samples from each he reports as follows:

Short headless tack, or brad. SS/14/74.

«This was found to be a homogeneous copper-base solid solution with elongated particles of lead (stringers). As these had been cut across their length they appeared as rounded grey-black particles (fig. 60). The structure showed pronounced twinning and had been clearly hot worked. The hardness was in the range 113-117 HVl which suggests that if this is, in fact, a tin bronze containing 9.4% Sn and 10.7% Pb, it must have had some cold work to finish it. This is confirmed by the well-marked right-angular shape of the corners.

Corrosion appears to have been relatively slight, and there is no sign of intergranular corrosion.»

(2) As a comparison, one of the many ship-nails found on the floor of the Punic Ship Sheds, which are currently being excavated (H. Hurst, *Excavations at Carthage*, in *AJ* LV, 1975, 11-40 and LVI, ii, 1977, 177-197) has been analysed by Mr G. C. Jones. I am deeply grateful to him for the following results, as I am to Mr. Hurst for providing the sample.

Carthage nail no. A77 XIV (26) 2937:

Cu, 98.8%; Fe, 0.3%; Sn, 0.2%; Pb, 0.2%; Zn, 0.14%; Ag, 0.10%; Ni, 0.1%; Mg. 0.01%.

This result indicates that the nail is copper not bronze. See too Dr. R. F. Tylecote's comments, on its structure, n. 3, p. 125 and Dr. N. H. Gale's on its lead isotopic composition, p. 131, n. 3

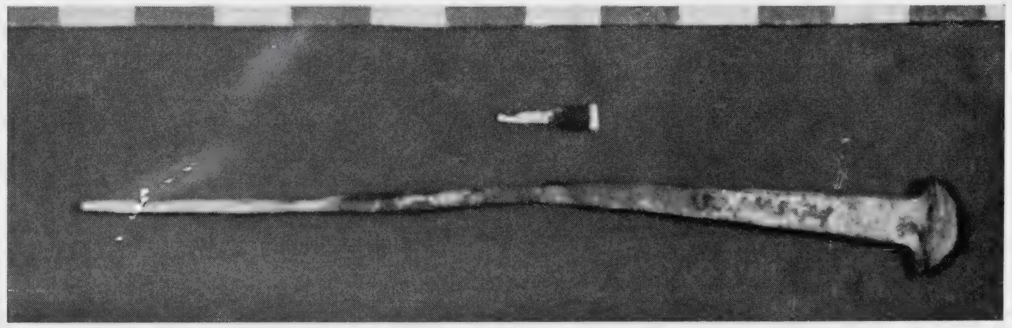


Fig. 59. – The two bronze nails.

Fig. 60. – Surface structure of small tack or "brad". The round grey particles are lead stringers seen in section. Note absence of intergranular penetration (×250).

Fig. 61. – Surface of head of large nail (×250). The section is taken across the long direction of the lead stringers showing their removal for a distance of 0.16 mm from the exposed surface.

Long Nail with a dome-shaped head. SS/13/74.

«This piece was cut along the direction of the lead stringers which have been turned round in shaping the head. Again it is a homogeneous solid solution with a slag phase (oxy-sulphide) and the lead stringers which are now shown as black lines (fig. 61). This specimen etched more rapidly than the brad which suggests that it has had more cold work which is what would be expected in the heading operation. The hardness is in the range of 153–178 HVl. The corroded appearence contrasts with the previous specimen. Intergranular penetration has now taken place removing the lead stringers for a distance of 0.16 mm. from the exposed surface. This is not much for 2000 years. Of course there will have been some general dissolution, but this could not have been much judging from the clean profiles of the two nails.» For a further metallurgical comparison between a nail from the Punic Ship (i. e. similar in character to the Sister Ship's) and another ancient nail from an unexcavated wreck in the vicinity, see Appendix III, p. 297 (3).

Shape and Size of the Nails

During the four seasons, hundreds of loose nails scattered throughout the site were examined annually. Their encasing layers whether of corrosion products or stone-like concretion, always camouflaged the original shapes (figs. 62 and 63).

Consequently the precise dimensions had to be worked out (*a*) from the radiographs, or (*b*) by taking casts or measurements from the voids within the stone-like concretions (once these had been sectioned), or (*c*) by breaking the thinner layers of blue corrosion products and measuring the cores that had once been metal. It was while he was performing the latter operation that John Wood had been surprised to find a solid metal nail SI/75 within the corrosion products because its outside covering was indistinguishable from the surface layer covering the completely corroded nails (it is, of course, the same material).

Other bronze nails probably survive on this wreck, but finding them would mean breaking the wood in which they are lodged, a drastic action that would serve no useful purpose.

In shape these Punic nails with their hammered domed heads and square-sectioned shanks, are no different from the majority of nails recorded on the wrecks of ancient merchantmen. But in size they do differ, the largest of the Punic nails being smaller that the largest from any other site. Further, the range of size on the Punic Ship is minimal. These differences are not entirely explained by the fact that some of the wrecked merchantmen are bigger than the Punic Ship, instead they are connected with the light but strong way the Punic Ship was built.

(3) As a comparison, Dr. R. F. Tylecote has examined one of the many ship-nails found on the floor of the Punic Ship Sheds at Carthage (see above); he reports:

«*Nail from the Military Ship Sheds Carthage. A77 XII.*

A cross section showed that the metal was an impure copper with a very large grain size. The structure was equiaxed and twinned. As the hardness was 102 HVl it was clear that the nail had been cold worked. Annealing at 500° C for several hours reduced the hardness to 58. There were a few inclusions which probably consisted of iron. The chemical composition given by Mr. G. C. Jones is a typical impure copper and no provenance can be ascribed to it.

The structure and composition of this nail agree very closely with that from the Kyrenia wreck. The only difference being that the grain size was finer, but this fact is not very significant – it merely indicates slightly different working and heating processes. The hardness (maximum) was 100 HV1 and the hardness after annealing was 38 HV which suggests a slightly purer metal, probably with a lower silver content.»

The larger Punic nails measure some 22 cm and the smaller, 4 cm.

Since the thickness of the average plank and rib are just over 3 and 10 cm respectively, 22 cm. nails are sufficient to span them and then have their points clinched on the surface of the timber. The longer nails were lodged in oak dowels. This gave added strength, indeed the dowels would by themselves have held a hull together, as was the case in one 2nd century B.C. wreck wherein nails were only used *inside* the hull to hold down such things as the keelson and floorboards (4).

a

b

Fig. 62. – *a*) A concreted iron object as found; *b*) After x-radiography has shown it to have contained nails; the concretion is cut in half revealing the hollows once filled by iron.

Nails (all reported to be copper) did, however attach the outer planking to the ribs of the Grand Congloué, Mahdia, Titan and Drammont 'A' (5). The only estimates of size that can be accepted relate to the Titan and Drammont 'A', their respective lengths being 25 and 20 cm. To judge from the cargo on the Mahdia site, that ship must gave been considerably larger; the evidence as to the size of the Congloué is too confused to be significant. It is, however, certain that all four ships were double skinned, so that their outer nails had to traverse two planks as well as a timber and so were bound to be longer than those on the

(4) J.-P. Joncheray, *L'Epave 'C' de la Chrétienne*, Premier Supplément aux *Cahiers d'Archéologie Subaquatique*, Nice 1975, p. 68.

(5) F. Benoit, *L'Epave du Grand Congloué*, *Gallia* Supplement XIV Paris 1961, Pls XXI, XXVI, fig. 77 and Pl. XXVIII respectively.

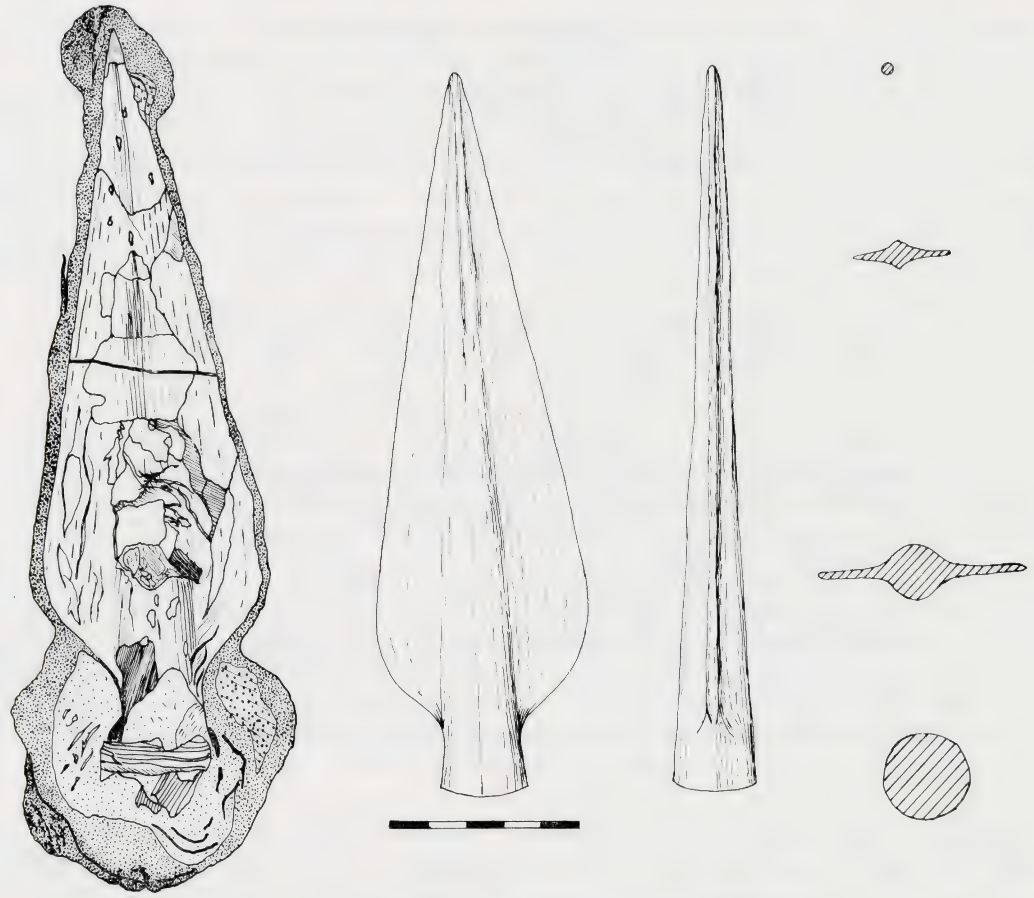


Fig. 63. – The latex cast of a spearhead taken from a natural mould (after iron corrosion products had been removed from the void) inside a concretion found on another wreck, in the group during our preliminary survey in 1970 (see Ch. I, p. 18).

single skinned Punic Ship. On the Congloué the maximum length of this type of nail is 43 cm. (6).

On the much longer, but single skinned Nemi ships, nails having the same function measure only 30 cm. (7). Some giant nails were recorded on both the Congloué and the Nemi sites. One found loose on the Congloué had a head 4 cm. in diameter and a shank 2 cm. across (8), while Ucelli illustrates a nail 60 cm. long. That no such nails were found on our site is significant, because it points to the entire structure being light, as would befit a fast oared warship with no heavy superstructure and no provision for passengers or cargo.

Small Nails and Tacks

The function of the small nails and possibly the brads, or 'headless' tacks, was probably to secure the tips of the scarphs to the planks on either side (fig. 64). Again, without dissecting the wood, it is impossible to be certain which kind was used. On the Sister Ship,

(6) Benoit, *op. cit.*, p. 189.

(7) G. Ucelli, *Le Navi di Nemi*, Rome 1950, fig. 154.

(8) Benoit, *op. cit.*, p. 191.

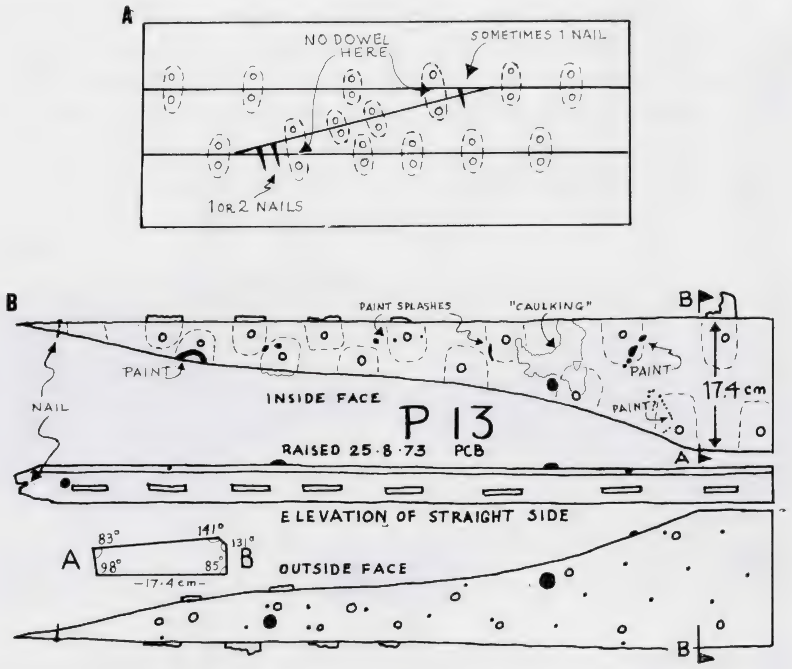


Fig. 64. – Nails fixing the ends of scarphs. A) Sketch of a typical straight scarph. B) Detail of the *s*-shaped scarph on "P 13" (note the bevelling of a spray deflector: section A-B) *Drawings by Peter Brachi* (1 : 10).

the 'headless' tacks appear to have fixed the bronze sheeting on to the ram because, although the tacks 2 and 3 on fig. 57 were found loose on top of the block that reinforced the sternpost, they fit the holes in the sheet of bronze from the ram (fig. 65).

Neither lead sheeting not drawing-pin tacks were found in the sounding of the Sister Ship's prow, but they did occur in quantity throughout the Punic wreck. Peter Brachi (architect to the mission in 1973) who drew each section of planking as it was raised, noted that the drawing-pin tacks fixing the lead to the outside of the hull, had been arranged on some planks in a "continuous closely spaced row along the perimeter, and on others in a diamond shaped pattern, about 8 to 12 cm. apart across their expanse. In several cases there are strings of tacks passing vertically across the face of the planks. One or two planks show horizontal strings of tacks". He concludes that the sheets of lead were probably rectangular and that when his drawings are eventually transferred onto the ship model it should be possible to work out the size of the sheeting.

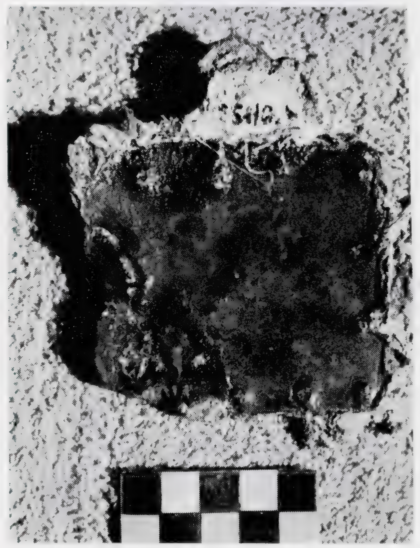


Fig. 65. – A fragment of bronze sheathing from the ram of the Sister Ship; note the remains of resin still adhering to it. *Photo by L. Basch.*

At this stage, the well documented system of sheathing on the Nemi Ships should prove useful as a guide.

As to the tacks themselves, neither radiographs, nor careful examination of their corroded remains have revealed the patterning on their undersides (that it existed is apparent from at least one surviving protuberance).

On tacks from other wrecks such patterns are made up of circular protuberances and bar in various combinations. It has been suggested by M. Georges Rogers (9) that because the same kind of tacks are found on land sites a typology of their patternings should prove useful. Since no less than 4 distinct patternings occur on the Nemi Ships (10) and the same 4 on the Drammont D (11), it is difficult to imagine that any one pattern would be significant, but without sufficient comparisons, judgment must be witheld. In any case, no pattern is distinguishable on the Punic Ship's tacks, unless some more delicate method of diagnosis can be applied to them by specialists at a future date.

Metal Bowl (fig. 66)

Fragments of a metal container which appears to have been either copper or bronze (SI/13A/73) were found on the western slope of the port ballast. Being small, entirely corroded and extremely friable, they were slowly consolidated in a solution of PVA, by Ray Strong. When they could safely be handled, Peter Ball reconstructed a segment of rim, estimating its diameter as 22 cm. Below the rim, which was rolled outwards, the body of the pan flared out and at one point under the rim remains of "corroded white metal" suggested a handle attachment, or possibly decoration. In this case the artifact, being both delicate and impregnated with PVA, was not sent to a laboratory for metal analysis.

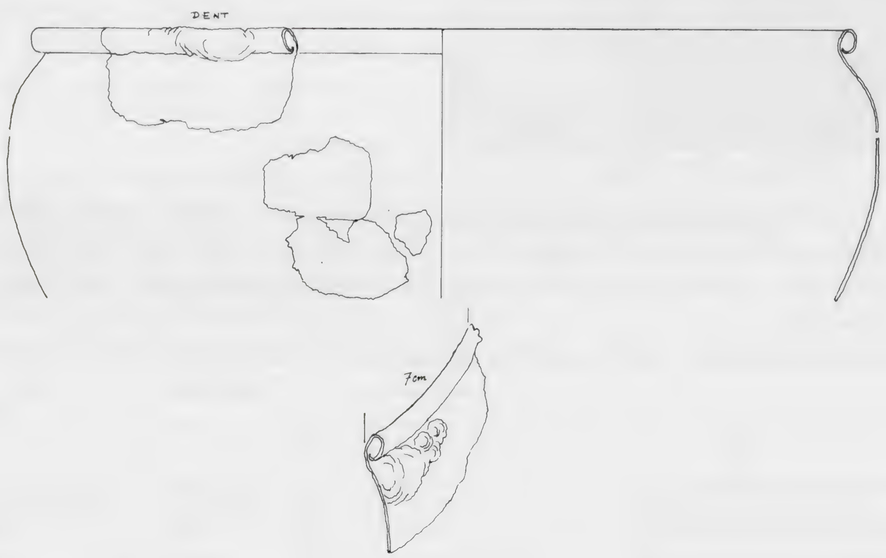


Fig. 66. – Fragments of corrosion product (originally copper or bronze?); bowl (SI/13 A/73) reconstructed by Peter Ball (1 : 2).

Lead.

The lead on the Punic Wreck was in an exceptionally bad state. A few scraps of metallic lead were found inside the ship, but the sheathing outside the hull was entirely corroded.

(9) M. G. Rogers, *Routes Romaines et Archéologie Subaquatique, ou une histoire de clous*, in *Recherche d'Archéologie Sous-marine de Fréjius St. Raphael*, Nice 1974, pp. 25-27.
(10) Ucelli, *op. cit.*, 162.
(11) P. Fiori, and J.-P. Jonceray, *Mobilier Métallique provenant des fouilles sous-marines*, in *Cahiers d'Archéologie Subaquatique* 11, Nice 1973, Pl. III.

On most wrecks sheathing torn loose during the sinking survives in a still pliable state, but the sheathing that remains attached to the wood by tacks will have been reduced to lead sulphides (by bacteria and by electrolytic action). Blackish in colour, such decayed lead had the consistency of tooth-paste. On the Punic wreck all the sheathing without exception, had turned into a bluish paste which rose in clouds at the slightest movement in the surrounding water. On land it dried into a powder.

Samples submitted to Mr. W. A. Oddy at the British Museum Research Laboratory were examined by emission spectrography, which showed them to contain: "lead with traces of silver and copper" (May 18, 1972, RL File No. 2504).

Later, a loose scrap of metallic lead from the Punic Ship and a sample of sheathing, from the Grand Congloué (where lead had survived in a normal way, as described above) were compared by Messers A. H. Jiggins and D. F. Sedgwick (Department of Metallurgy, Polytechnic of the South Bank) with the following results. Chemical analyses of lead from:

The Punic Ship: 105 parts of Ag per 1,000,000 of Pb, 18 Antimony.

The Congloué: 35 parts of Ag per 1,000,000 of Pb, 57 Antimony.

The above chemical analyses are important only for the comparison with lead from other ships etc. The method which follows differs in that it is capable of giving a direct indication of the geographical origin of lead by comparing its isotopic composition with the isotopic composition of lead from ancient mines. Results consequently depend on the knowledge of ancient mines, but this knowledge is still being amassed, so that the full significance of the determinations given below may not become apparent for some time. Meanwhile, useful comparisons can be drawn from some relevant, archaeological samples.

Lead Isotopic Determinations (12).

Lead isotopic determinations have been carried out on specimens from the Punic Ship, the Sister Ship and the Grand Congloué by Dr. N. H. Gale and Mrs. V. E. Chamberlain at the Department of Geology and Mineralogy, University of Oxford. The isotopic compositions found are:

SAMPLE	$^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{207}Pb/^{204}Pb$
Bronze nail SI/75, Punic Ship	2.0921	0.8449	15.672
Decayed lead sheathing, Punic Ship	2.0764	0.8371	15.664
Bronze nail SS/13/74, Sister Ship	2.0902	0.8475	15.698
Bronze tack SS/14b/74, Sister Ship	2.1088	0.8534	15.771
Preserved lead sheathing, Grand Congloué. .	2.0753	0.8370	15.700
Bronze coin, Carthage, 300-264 BC	2.0754	0.8404	15.729
Bronze coin, Carthage, 300-264 BC	2.0724	0.8360	15.731
(Both coins from Sardinian mint, SNC Cop 144 ff).			

(12) I am deeply grateful to Dr. Colin M. Kraay of the Heberden Coin Room, Ashmolean Museum, Mr. Simon Bendall of A. H. Baldwin and Sons Ltd and Mr. Peter Seaby of B. A. Seaby Ltd. for generously supplying Punic Coins to Dr. Gale for these tests.

Dr. Gale writes:

"There are strong similarities in isotopic composition between the lead sheathing from the Punic Ship and the Carthaginian coins from a Sardinian mint. On the other hand galena from the Monte Poni Iglesias mine on Sardinia has a quite different lead isotopic composition, so that definite conclusions must await a more extensive sampling of Sardinian ores. The isotopic compositions of the lead in the bronze nails SI/75 and SS/13/74 are similar to each other, but dissimilar to that of any lead ore so far analysed. The composition of the headless tack SS/14b/74 is similar to that of galena from Bottino, Tuscany. This work continues and it is hoped that with better samples and more research concerning ancient lead mines, an important addition may be made to the other evidence relating to the region where this ship was built" (13).

Fig. 67. - Folded lead sheathing (top) stowed in the "kitchen area". In the foreground: brushwood and the peg-bottoms of two amphorae. *Photo by J. Blair, National Geographic Society, U.S.A.*

The quasi-total absence of lead artifacts inside the Punic Ship is astonishing by contrast with the confetti-like scatter of brailing rings, fishing tackle and the like, found on most wrecks. Even supposing that the ship had been salvaged shortly after sinking, it would have been very unlikely that the salvors could have removed every vestige of the "plumbing", let alone the much smaller objects such as fishing line-

(13) The following results have been obtained by Dr. Gale from 3 preserved scraps of lead sheathing and a further decayed sample, all found at the end of the excavations. Given in addition and for comparison is a ship-nail from the current excavation of the Punic Ship Sheds on the Ilot de l'Amirauté, Carthage (personally communicated by Mr. Henry Hurst FSA, to whom I am also indebted for this sample).

SAMPLE	$^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{204}Pb$
Preserved lead sheathing:			
SI/271/74	2.07673	0.83640	15.675
SI/247/74	2.08096	0.83733	15.652
SI/321/74	2.08319	0.83757	15.712
SI/322/74	2.08453	0.8379	15.678
Decayed lead sheathing	2.0 344	0.83792	15.698
Nail; Carthage Ship Sheds A77 XIV (26) . .	2.07511	0.83768	15.664

These figures suggest *a*) that the lead used in the Punic Ship's sheathing had been obtained from more than one source; *b*) that the lead in the Carthaginian nail has a composition that is almost identical with that of the lead sheathing sample no. SI/271/74 and that both are similar to the previously analysed Carthaginian coins that were minted in Sardinia. As noted earlier, page 123, this nail is copper rather than bronze, its lead content being only 0.2%.

weights. Conversely, in excavating the site, we could not have missed these things, however decayed their condition, when we habitually retrieved large quantities of even smaller and more delicate objects such as leaves and bits of string.

It can only be concluded that there had been no brailing rings on board, either in boxes of spares, or attached to sails; probably mast and sails had been removed, as was the custom on oared ships going into battle. Nor can fishing tackle have been carried (as it usually was on merchantmen in order to supplement the supply of fresh food during a voyage). Finally the pumping system and general plumbing of the ship must have been rudimentary, if it existed at all, for it to have left no trace.

Only one scrap of powdery lead piping was found on the northern slope of the port ballast (not a sealed area; M10 on Plan fig. 73). Measuring 12.4 × 3 cm in its distorted elongated state, it was immediately measured and drawn underwater by Paolo Giacalone who estimated the reconstructed pipe as 9 × 5.5 cm.; the remains disintegrated before they could be lifted.

The Punic Ship was no exception in one respect: it had carried a few sheets of lead for repair purposes. Their folded and powdery remains lay under a length of rope, beside the eye-splice knot, in the midship's "kitchen" area (i.e. under the break in the keel). (fig. 67). The particles of lead sulphide being lighter than the grains of sand that covered them and as easily "blown away" as the fibrous remains of rope, it was impossible either to clean the sheets for photography, or to make a reliable estimate of their unfolded dimensions. But again, it is probably only a matter of time before the dimensions of the lead sheets on the hull can be worked out from the marks left by the tacks.

Only 5 small, shapeless scraps of metallic lead were found in the course of 4 seasons of excavation: bluish-black in colour, one millemetre thick and respectively 4, 5, 4.7 and 4.5 cm. long, three of the scraps were "sealed" with the dunnage between Ribs 33 and 34 (F 73, M 19).

S1/210b was subjected to qualitative analysis by emission spectography at the British Museum Research Laboratory, indicating "the presence of lead, copper, silver and bismuth, also traces of several other metals. The predominant element was lead" (May 3, '73, RL Files Nos. 3106 and 2504).

Two similar scraps, 5 and 6 cm long, (S1/321, Plan P. 16 and S1/322 by the keel–scarph) were found in 1974. There were no tack marks on any of these fragments and nothing to suggest that they represented the otherwise decayed sheathing from the hull; indeed, the "sealed" context of the first three suggests that they had no connection with the outside of the hull.

This uniquely meagre list of lead objects is not surprising on an oared warship. Being part of a fleet served by supply ships, there would have been little need for fishing tackle, or for pumps, washing facilities and other necessities of daily life, that had to be provided on merchant ships. Nor is the absence of lead-stocked anchors surprising, because in this shallow depth they would have been among the first things to have been salvaged. We can however deduce what the Punic warship's anchors would have been like, because in 1970 we found a warship – type anchor on a nearby wreck, but one that lay further from the shore (14).

Iron

In seawater iron is quickly—and sometimes entirely—destroyed. By 1974, for instance, we hardly recognised the modern pitons we ourselves had forged in 1971 (for

(14) H. Frost, *Relitto di una nave punica*, in *NSc* XXVI, 1972, 633 ff., fig. 5; *Segreti dello Stagnone*, in *Sicilia Archeologica* 13, Trapani 1971, 10–11, figs 6 and 7; *The Discovering of a Punic Ship*, in *IJNA* 1, London and New York 1972, 114 ff., figs. 4, 5 and 6.

marking out the wreck), because they were already very decayed and concreted. But in general, when iron survives as a brownish partly oxidised sulphide, or as a lining to the voids inside stone-like concretions, it is easier to identify than the corrosion products of other metals. Even a layman can recognise such 'rust' as iron, but this is not the case with the rarer form of corroded iron objects, such as 'Mercury's hat' and the 'Corvus' (described below), which have retained their surface shape but not their metal content; they do need to be examined in a laboratory.

Structure being our major interest on this wreck, it is however the nails that are of first importance. During the first season we were puzzled by the quantity of concreted iron nails lying loose on the site, when only bronze nails had been found in the wooden shell of the ship. It was well into the second season before we discovered the rusty remains of 5 iron nails, transpiercing an *un-mortised* plank (consequently not an outer part of the ship). Originally, this plank (P9/72) had not been in contact with the water; it had reinforced the keel-structure, inside the hull, as did the short oak plank (P/7/72) which also had rust in its nail holes (see p. 352 ff. and Plan P15-18 and M 21).

It became apparent that iron nails were never used in the parts of the hull that came in direct contact with seawater. The remains of other iron nails were later found in: - the walnut 'shield-holder' (T2/74), – the curious maple-wood, bracket-like fragment (P35/74), – and small maple planks (P34/74) only 6.5 cm. wide (i.e. too small to be from the shell of the ship). These three objects evidently belonged to its superstructure.

The stone–like, loose concretions encapsulating the remains of iron were not sent to laboratories for metal analyses, but rather for X-radiography and sectioning which would show the original shape of the objects they had contained. Nevertheless the linings of some such concretions were briefly examined in the British Museum's Research Laboratory (May 4 1973, RL Files 3106 and 2504) and the X-radiography returned with the confirmation: "these nails were undoubtedly of iron".

Later, Mr. G. C. Jones in the BMNH Department of Mineralogy (May 28, 1974) extracted a 2 mg sample from the centre of a similar concretion after it had been sectioned, and subjected it to qualitative spectrographic examination with the result:

"*Nail S1/73*: Elements Major: Fe, Minor: Si, Traces: Mg, Cu, Mn, Al.".

Iron was found the following year on the Sister Ship, and exceptionally, three samples were submitted for analysis, because I could not believe my eyes on seeing so much iron, in such unlikely places on that wreck. It occurred: *a*) in the ram, as nails *below the waterline*; *b*) as a lump of corroded, *but unconcreted* metal lying beneath the ram; *c*) as nails on such ribs as were visible.

Mr. Jones made (Feb. 18, 1975) the same kind of spectrographic examination as before:

"*Nail from starboard 'tusk' of ram, SS/74*: no metal detected, only iron corrosion products and silica.
Elements: Major Fe + Si, Traces: Pb, Cu, Mg, Mn, Ca, Al.

Lump of corroded metal SS/17b/74: no metal, iron corrosion products.
Elements: Major Fe + Si, Traces Cu, Pb, Mg, Mn, Ca, Al.

Filling inside dowel hole on rib SS/TXZ/74: no metal present, iron corrosion products.
Elements: Major Fe + Si, Traces Cu, Mg, Mh, Ca, Al".

The Ram-nail is curious, because it will be remembered that bronze nails were present on both wrecks; indeed the ram of the Sister Ship had had its "swaddled" framework sheathed in bronze, attached by bronze "headless" tacks. Why then should its structure *below the waterline* have been nailed with iron? Even assuming that the resinous material in the

swaddling (see p. 263) had been fairly waterproof, the explanation must be that the ram-structure itself had not been intended to last as long as the rest of the hull, but that while it lasted, it had to be strong and carbonized iron nails were harder than bronze.

This detail corroborated the other evidence as to the dispensability of rams.

On the Sister Ship's ribs, the iron nails were on the topside, which confirms our general observation on this unexcavated wreck viz, that unlike the Punic Ship its hull has been lined with floorbords (on other wrecks only the keel reinforcement and the riders are nailed, the intervening boards being loose).

Finally, Mr. Jones' identified as iron some nails in a mortised plank (S1/33/74) which, though it was found loose on the Punic site, was uncharacteristic of the rest of that Ship's planking; it might have been washed in from the nearby Sister Ship. He applied the same test as before:

" Sample from nails S1/33/74: no metal detected, only iron corrosion products and silica. Elements: Major Fe + Si, Traces Mg, Mg, Al ".

and concluded that " these nails differ only in trace elements from the other similar samples from the Sister Ship so that all were probably iron ".

Shapes and Sizes of the Iron Nails

In the Punic Ship both iron and bronze nails had the same shape and size range. Measurements of the concreted examples showed none to be longer than 22 cm. The shorter nails having survived only as ' rust ' in wood, could not be measured so accurately, but the nail through the scarph in the 6.5 cm. planking (P34/74) cannot for instance have been shorter than 4 cm; that is to say the length of the smallest bronze nails.

On other wrecks, details are scarce of the comparative size range between iron, and copper or bronze nails.

On the 1st century A.D. Nemi ships, the largest iron nails were over 50 cm. (15); both metals were used, copper on the outside and iron inside and in the superstructure.

On the 1st century A. D. Drammont D wreck, a basket containing both copper and iron nails was discovered. The iron nails ranged from 21–7 cm., but it is not clear whether any other iron nails existed elsewhere on the wreck (16).

On the 2nd century B. C. Chrétienne C, only iron nails were used and those inside the hull (the shell having been fixed to the skeleton by dowels). M. Joncheray notes that these nails penetrated the timbers to a depth of 5-6 cm. (having passed throught the thickness of a floorboard, the total length must have been just under 10 cm.); he observes that " the absence of copper nails is unusual, Republican hulls being frequently nailed with copper "(17). He does not say whether or not any larger concreted iron nails from the actual structure of the ship were found loose on the site.

On the 2nd century B. C. Congloué, a giant iron nail of unknown function is described: 65 cm. long, it had a round shaft 2 cm in diameter (18).

Though published comparisons are inadequate, my own experience of wreck sites suggests that the giant iron nails found on the Congloué and Nemi ships were probably not

(15) Ucelli, *op. cit.*, p. 155.
(16) P. Fiori and J.-P. Joncheray, *Cahiers d'Archéologie Subaquatique* II, Pl. III.
(17) J.-P. Joncheray, *Chrétienne C*, p. 68 and photos 42 and 59.
(18) Benoit, *op. cit.*, p. 195.

exceptional. Some iron-nailed superstructure survived in Lake Nemi, but nothing comparable has been found in sea conditions. At sea, it might take years of systematic excavation (and few wrecks have had this treatment as yet), followed by much laboratory work on the concretions, before a full range of iron nails could emerge. Hence the gap in our knowledge. On the Punic wreck where all concretions were examined, it is certain that no giant iron nails were found. Consequently, as with the size-range of the bronze nails, this points to the entire ship having been lightly built.

Miscellaneous Iron Artifacts

Very few iron objects survive; this would not be remarkable on an 'ordinary' wreck, because iron objects are usually rarer than the leaden. It is, however, surprising on a warship-wreck of a period when armaments were largely made of iron.

Three explanations spring to mind: first, the absence of armaments, coupled with the 7° angle of the keel, supports the hypothesis that the ship had been rammed. Being in very shallow water, the men fighting on deck might either have floundered away, or been captured by the attackers. They were unlikely to have been trapped inside the hull; indeed

Fig. 68. – *a*) Iron dagger (cast taken from a natural mould of concretion).
b) Drawing of the same (SI/333/74).

the three certain scraps of human bone that we found on the wreck imply that at most three men, but more probably only one, went down with the ship. Secondly, the angle of the keel certainly means that the forepart of the ship had protuded above the surface and near the shore, so that salvors would have gathered as soon as the coast was clear, to

Fig. 69. – Iron object unidentified, known as "Mercury's hat".

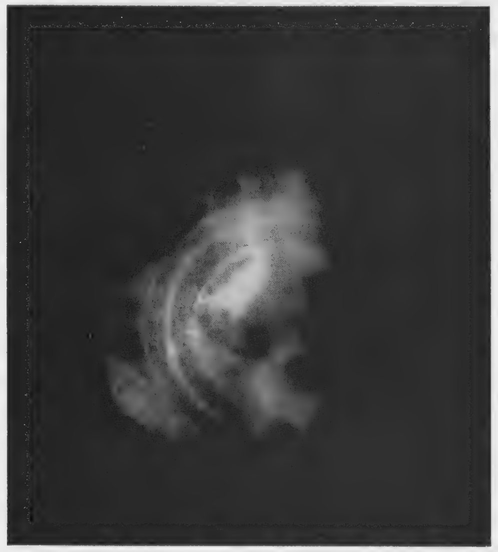


Fig. 70. – X-ray of iron rings in a concretion.

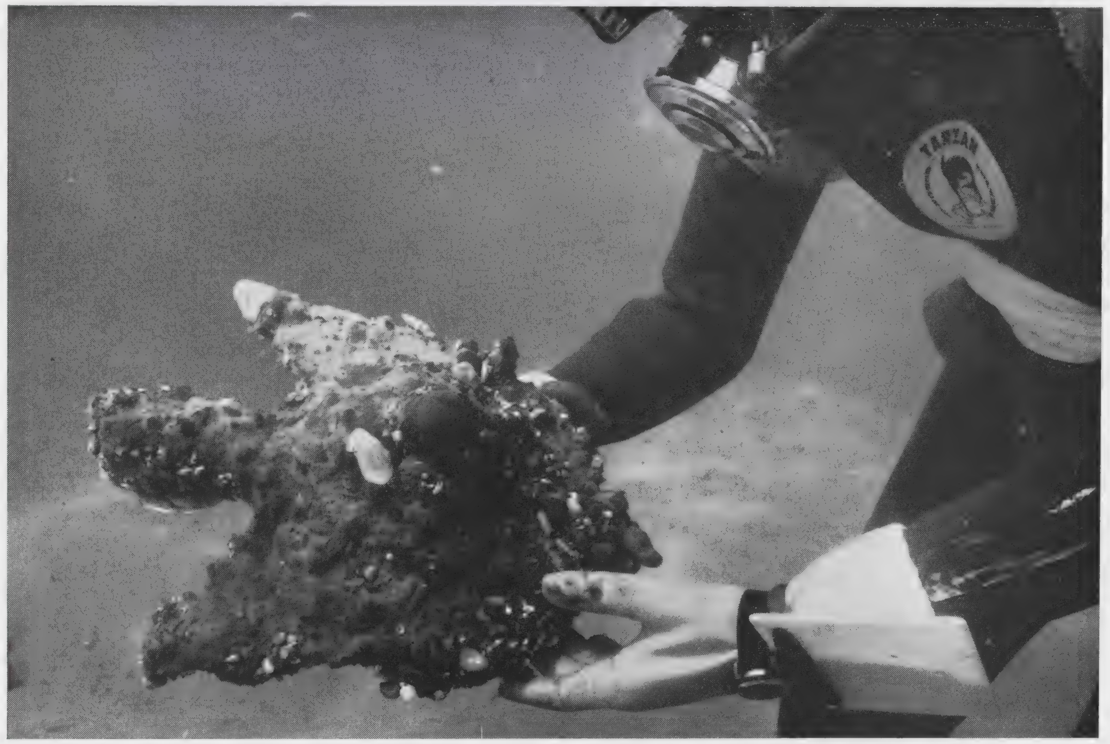


Fig. 71. – The iron spade. *Photo by J. Blair, National Geographic Society, U.S.A.*

strip the hull of such valuables as weapons. Thirdly, the site itself was unfavourable to the preservation of metals, being influenced by wave-movement, also by the accumulation of decaying *Poseidonia,* (i.e. fast moving water spreading anaerobic conditions). Further, a distinction must be drawn between different categories of iron objects: *a*) a compact mass such as a nail (which in the early stages of decay would probably be protected by the wood that surrounded it), and *b*) more elaborate artifacts such as helmets and armour which, reaching the bottom without any protection, might well rust and break before any concretion could form around them.

Only one knife blade was found (S1/333/74), fig. 68.

It lay some 90 cm. deep at the bottom of a trench at the eastern, landward base of the starboard ballast where, though it was not sealed by organic matter, it was unlikely to have been intrusive. An X-ray photograph (made immediately, thanks to Dott. Vito Griffo at the Marsala Hospital) revealed the blade. Subsequently, the conservator Michael Kailas, laboriously cast the object. Unlike the concreted spear-head mentioned below, this concretion around what had been only a thin blade, could not be sectioned through its cutting edges because it had been slightly bent. Instead it had to be broken and used as a piece-mould, the cast parts being eventually reassembled. The blade is flat, with a lump (possibly the remains of rivets?) on one side at the handle end. Its slight incurving towards the handle, suggests a dagger of the Roman period (19).

One of the rare iron objects to have retained its surface shape, (S1/140/71) fig. 69, was christened 'Mercury's hat' by Mr. W. A. Oddy when he examined it in 1972, reporting: "Qualitative analysis suggests that iron is the major, non marine constituent of this object. Radiography revealed little about the original shape of the object, but does suggest that it is hollow. Hence there is some doubt as to whether the object as it now appears is itself a man-made artifact, or whether it has actually been deposited inside a hollow space". (May 18, 1972, RL. File No. 2540).

Fig. 69 shows it to be something like a bicorn hat with beading above its rolled brim which, at one end is cut off leaving two truncated ends but at the other joins together in a point.

Though I can suggest no comparison that explains its function, the fact that this once iron object had *external* shape, links it with the *Corvus* fig. 2, (so called because of its resemblance to Folard's illustration of the weapon) discovered in 1970 near the warship anchor and a concretion containing an iron spearhead fig. 63 (20). The *Corvus* unlike 'Mercury's hat', is not hollow.

Related Iron Armaments

As a group, the *Corvus,* spear-head and warship-anchor are worth recalling in connection with the Punic Ship, because of their probable association with another warship of the same period. The site from which they came lay some 500 m. from the Punic Wreck; it too was marked by ballast stones; it will be remembered that we sounded it in 1971 (shortly before discovering the Punic Wreck), but found no wood. Possibly the ship had capsized and then been washed away and destroyed by the sea. Certainly its contents

(19) Daremberg, *Dictionnaire des Antiquitées Grecques et Romaines,* Vo. 4 765, fig. 5872.

(20) H. Frost, *Relitto di una nave punica,* in *NSc* XXVI, 1972, 651 ff and fig. 4, 5 and 3 respectively.

were spread over a fairly wide area (in additon to those mentioned, they included some hitherto unidentified metal concretions). These objects survived because they lay further offshore, beyond the breaking waves and decaying *Poseidonia*; being in deeper water they would also have been more difficult to salvage.

In 1970 when I first saw the *Corvus* underwater (fig. 2, p. 17), I was puzzled by its condition and took a surface chipping for a metal test.

Microscopic examination of the external chipping by Mr. Oddy, showed the material to be grains of sand cemented together by a black matrix: " this black material examined by x-ray diffraction analysis was shown to be similar, but not identical to iron sulphide. A qualitative spectrographic examination indicated that iron was the major metal present in the matrix, and so the black material might be impure iron sulphide " (June 22, 1971, RL. File No. 3106).

This was inconclusive, because as Miss Lucy E. Weier has pointed out: " hydrogen sulphide reacts with ferrous ions in the water or sediment to form iron sulphide which precipitates with the calcium carbonate. This offers an explanation why even pottery . . . can be covered with iron containing concretions " (21).

In 1971 after the *Corvus* had been raised, a better sample was cut from its hard internal core, and this second sample was conclusive; Mr. Oddy wrote: "this is obviously corroded iron, and the identification has been confirmed by a qualitative analysis by emission spectrography. The corroded layer was found to contain; iron, aluminium, silicon, manganese, sodium and titanum, the predominant element was iron " (May 4, 1973, RL. Files 3106 and 2504).

Had the Punic Wreck also lain further offshore, we might have learned more about the armaments of a liburnia. As it is, there is little to add: only the X-radiograph of another concretion showing two rings and what appears to be a transverse bar, which recalls some kind of broach (fig. 70). Again, this object was too complex to be cast from a simple bisection of its concretion. So far, it has also withstood our attempts to use its fragments as a piece-mould.

Finally, a quite unambiguous object is the spade (fig. 71).

The metal content is obviously iron corrosion product, but whether the spade is ancient or modern we may never know; it was found on a superficial level, some 3 metres east of the break in the keel.

The only remaining iron consists of three droplets, 3-4 mm. long, recovered from the air-lift bag in 1971, during the excavation of the stern. They are worth noting because they come from an area 'sealed' by organic matter. Mr. Oddy comments: "these 'droplets' consist mainly of iron and are pieces of nodular iron corrosion product. They cannot be droplets of smelted iron, because it would have been impossible to construct a furnace on a wooden ship in the 3rd century B.C. which was capable of smelting iron ". (RL. File No. 2540, May 18, 1972).

HONOR FROST

(21) L. E. WEIER, *The Deterioration of Inorganic Materials Under the Sea*, in *Bulletin* 11, Institute of Archaeology, London 1974, p. 140.

XI. POTTERY

STRATIGRAPHY: CRITERIA FOR DISTINGUISHING CLOSED FROM INTRUSIVE MATERIAL (FIGS. 72 AND 73)

In September 1972 we made the first sounding in order to determine the nature of the bottom on which the Ship had originally come to rest. At this point by the keel (P 17 on Plan fig. 73), the following strata lay beneath the compacted sand:

1) a felt like layer composed of *Poseidonia* fibres that could be prised off in sheets;

2) a layer of decomposed lead (the sheathing that had been torn from the outside of the hull);

3) a stratum of small shells (i. e. the animals that had gathered on the newly sunken ship to feast on the organic matter it contained);

4) a thick, compacted layer of flattened, sulphur-yellow balls (of rolled *Poseidonia* fibres) which had, presumably, been trapped under the wreck;

5) virgin sand.

We discovered later that the first three strata varied both in depth and in number from one part of the site to another, but the compacted balls were consistent throughout and certainly marked the limit of the wreck-formation. It was difficult to cut through this layer which, underneath the port side of the hull, at square O 16 (fig. 74 *a–c*), attained a depth of some 69 cm.

In the virgin sand at square P 17 (the first sounding) we found a rim sherd with handle attachment, made of coarse, flaky brownish ware (Catalogue number 130/72, fig. 75 *a*). Two years later at the end of the excavation, three sherds of similar ware (Nos. 540–541) were lifted from the same virgin stratum at the nearby square O 18. William Culican describes them as " hand-made and possibly prehistoric (although handmade cooking pots with ledge or lug handles were in use in Sicily throughout the 4th and 5th centuries B. C. and possibly later; e. g. TAMBURELLO, *NSc*, 1969, p. 300, fig. 41) ".

Again in 1974, but this time on the surface of the seabed some 200 m. beyond the limits of our wreck, to the north west, we raised another such sherd: " 78/74, part of a vessel wall with a tunnel handle; grey coarse ware with multiple white grits and smoothed dark grey on the surface " (fig. 75 *b–c*).

Prehistoric objects such as a stone axe head and some flints had been found on the nearby mainland shore, beside the *Caserma* which had been our base in 1971. Well known prehistoric sites exist on the Egadi Islands and at the village of Paceco (between Trapani and Marsala). The possibility of finding a prehistoric wreck in the vicinity is therefore intriguing, but the sherds associated with the Punic ship are here mentioned only in relation to the wreck's stratigraphy.

The technique of marine excavation being unfamiliar to many archaeologists, our criteria for distinguishing closed from intrusive finds needs to be stressed. While it is a

truism that every wreck that sank by accident represents a " little Pompeii " that reached the seabed at a certain moment in time, it is equally true that before and especially after that moment, this " closed group " will be contaminated. To some degree, all sunken ships form an obstruction on the seabed. Being in shallow water, the Punic Ship's ballast piles were bound to trap things that would otherwise have been cast onto the shore by the waves. This was evident from an accumulation of modern bottles and plastic detritus; in a zone so full of ancient wrecks, ancient pottery would have washed onto the site in the same way. Consequently the dating of the Punic Ship by its pottery had to be approached with caution.

Only those objects found *under the ballast stones and in contact with the wood* of the hull, or *held within a mass of plant material*, or *in contact with the lead sheathing* that had covered the outside of the hull can be considered as belonging to the material that sank inside this ship.

The Distribution Plan, fig. 73, summarises the relationships of the wood of the hull, the plant material and the ballast stones, as they were eventually revealed by the excavation (the evidence for this: the phase-plans made with mobile grids, templates etc. have been described in Chapter III).

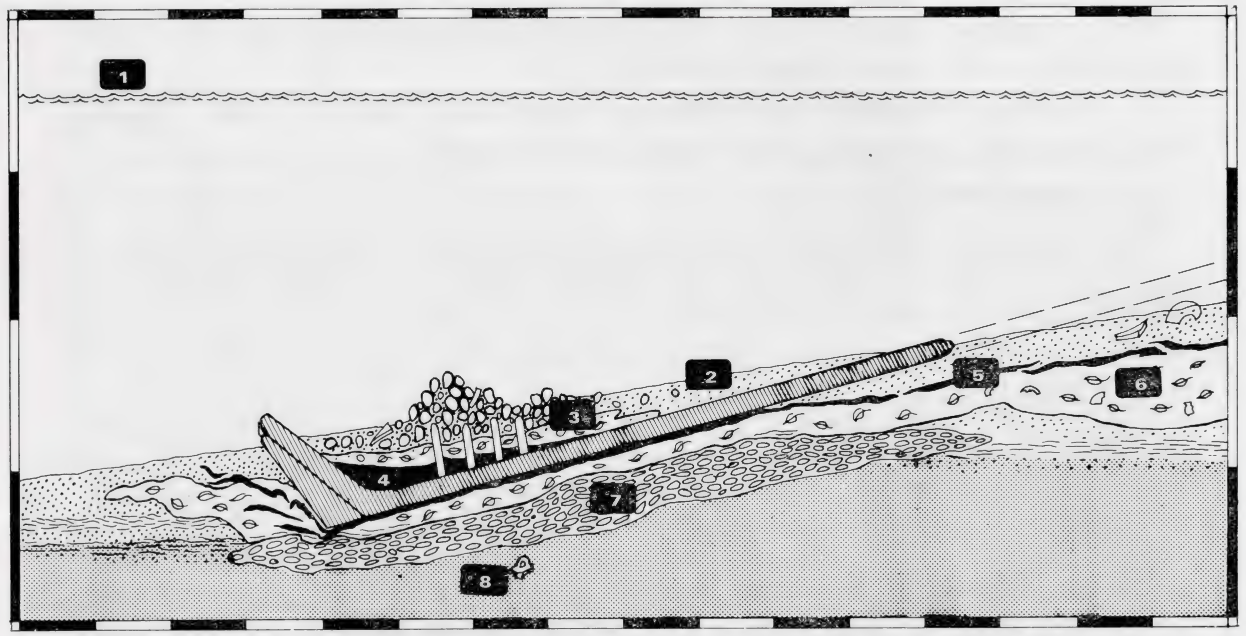
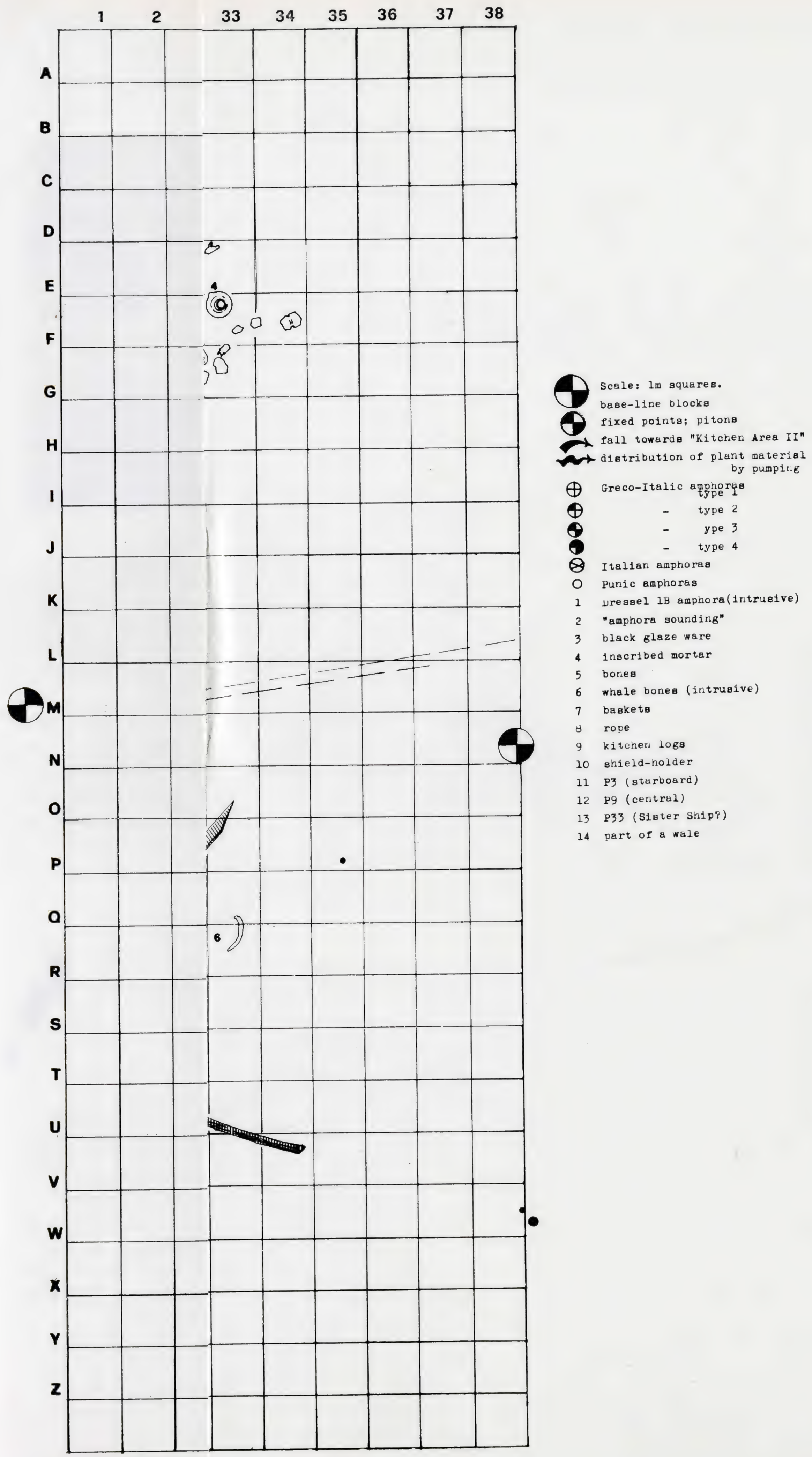


Fig. 72. – Schematic section: 1) sea level; 2) surface sand and ballast; 3) vegetable matter, mostly dunnage; 4) "gunge": vegetable matter of peat-like consistency; 5) lead sheathing detatched from outside of hull; 6) vegetable matter: brushwood etc. sucked under hull from " kitchen area I "; 7) flattened and compacted balls of *Poseidonia* fibres; 8) prehistoric sherd in "virgin" sand below the wreck-formation.

The schematic Section, fig. 72, summarises the stratigraphy of the site.

The three sets of records used after the excavation to check the provenance of individual objects are: 1) the Register of Finds (that had been kept at base); 2) the Excavation Log (that had been kept on board the boat); 3) the daily set of underwater photographs. Each of these records being dated, the three dimensional position of any object can now be checked by cross reference. For example: the find place of a sherd will be described in the Register in relation to a particular part of the ship's structure. Its stratigraphic position



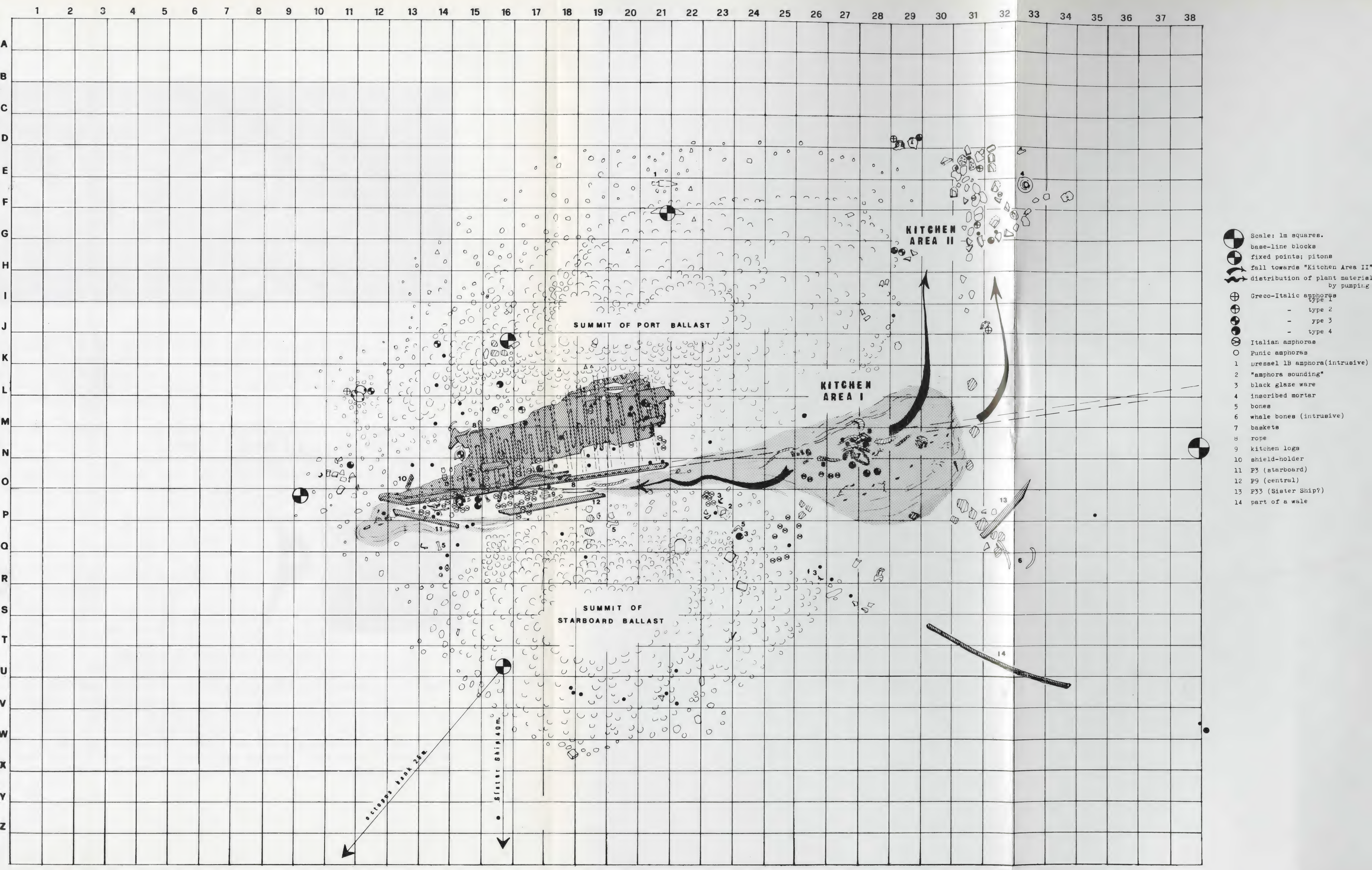
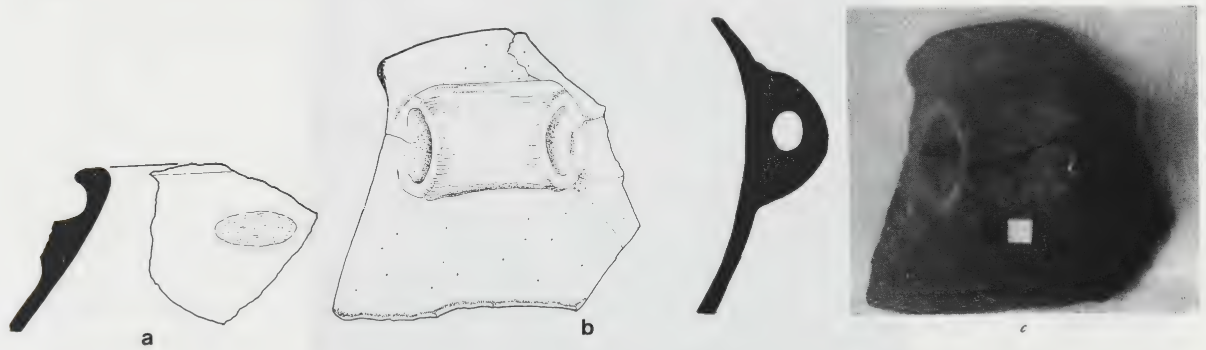


Fig. 73. - Distribution plan.

a *b* *c*

Fig. 74. – *a*) Sounding made in 1973 after the hull had been raised, at Square O 16 (v. fig. 73). A layer of lead sheathing from the outside of the ship is succeeded by a stratum of sand which in turn covers a thick layer of *balls* (roled *Poseidonia* fibres); *b*) Detail of these flattened and compacted balls. Note the admixture of the shells of animals that had been attracted by the newly sunken wreck. The blade of the knife measures 14 cm.; *c*) In this particular part of the site a depth of some 60 cm. of balls had been removed before the " virgin " sand was reached; it was in this final stratum that prehistoric pottery was found.

will be determined by the entry in the Log (which will state whether the surface of the site was being cleared on the date in question, or whether deep trenching was in progress). This information will then be confirmed by the photographs taken on the same date; photographs such as figs. 76 and 77. As on land, there will of course be some anomalies. At the one point a modern anchor ploughed a furrow through this wreck, upsetting the strati-



a b *c*

Fig. 75. – *a*) SI/130/72; *b–c*) SI/78/74 (1 : 3).

graphy (see figs. 8 and 78); in such cases I have appended an explanatory note in italics in the pottery section that follows.

Inevitably, we raised a great many intrusive sherds; we were also impelled to raise significant objects from the surroundings; both are given in Appendix II.

What emerges clearly from our records is that certain amphoras such as: the Greco-Italic types 1 and 2, the " Italian " type 3 and the Punic types 4 and 5, had indubitably been carried on board. The same applies to most cooking pots and all beakers. Not

Fig. 76. – Inside the keel cavity at square Q 14, in 1971; an amphora handle and peg bottom on top of the dark peat-like "gunge" that filled the cavity.

Fig. 77. – An "Italian Amphora type 3" (SI 308/74) as found underneath the keel in a stratum of lead sheathing resting on compacted *Poseidonia* balls (see fig. 83); beside it, note the fragments of the small pot (SI/149/73) (fig. 102 *d*), and a beaker (SI/313/74) (fig. 102 *n*).

Fig. 78. – Area where a modern anchor (the remains of which we found) had ploughed through the wreck bisecting the amphora in the center of this grid.

a single beaker sherd was found outside a closed context. The connexion of other objects, though not less certain, was less easy to establish in this zone so filled with wrecks that pot-sherds cover the seabed along more than two kilometres of shoreline.

Honor Frost

The Pottery from the Wreck

Some of the pottery from the wreck has been described and illustrated in the preliminary reports that appeared in the *International Journal of Nautical Archaeology* (vols. 2, 1973, pp. 33–49 by Honor Frost, and vol. 3, 1974, pp. 43–54 by W. Culican and J. E. Curtis). Certain sherds and parts of vessels published in these reports have since been augmented by more fragments, so the first drawings have been superseded by those presented below. Further, it is now clear that many of the fabrics originally thought to be grey are the result of discolouration by hydrogen sulphide present in the water. This is clearly shown in cases where adjoining sherds comprising a single vessel, but found in different parts of the wreck are now of different colour, some deep grey and others their original red or buff. This has made colour recognition very difficult and the description "grey stained" in the following discussion indicates that the original colour (if not grey) cannot be ascertained. Many other sherds given normal colour descriptions are in parts stained or tinged grey. This change of colour was not always taken into account in the preliminary reports so some of the early descriptions must now be considered as invalid.

Naturally some of the identifications and attributions made in the preliminary reports have required modification as a result of later discoveries and work on the material; this will become clear in the course of the following report. Lastly it should be remarked that only at a late stage of the excavation was it possible to make an overall assessment of the ship's contents, and it is now clear that certain pieces which were tentatively associated with the wreck do not come from it and vice versa.

The wreck being one of a group, all the pottery from it was registered with the prefix SI (i. e. Singmaster, the finder) followed by a serial number and the year of finding. The serial numbers began afresh each season. For convenience the SI prefix has been omitted from this discussion. All those items certainly associated with the ship have been marked with an asterisk, and those pieces without such a mark belong to " floating " material that cannot with certainty be said to belong to the ship's contents, but on the other hand are not obviously intrusive. The letter and numeral preceeding the serial number refer to a grid–square on the Distribution Plan fig. 73.

It is clear from Miss Frost's introductory remarks on stratigraphy why there must inevitably be such a group of material on practically every inshore wreck. Pottery recovered from the site which is clearly intrusive has been lumped together with the pottery from the surrounding area and is presented in Appendix II at the end of this volume. Miss Frost has also defined the system used on the site to differentiate the provenance of individual pieces and has commented on the stratigraphy in general. The distinction between pottery from closed areas (i. e. marked with an asterisk) and pottery found in other levels that is probably but not certainly associated with the ship, must be borne in mind by students of the following report. Although it does not appear at present that if the " floating " group of pottery were to be ignored the date suggested by the ship's pottery would have to be changed, it must be stressed that most of the parallels noted are insecurely dated and the presence or absence of the " floating " group might be significant in the event of a future re–assessment.

Both W. C. and J. E. C. attended the 1972 excavation to study the pottery; thereafter we returned separately, J. E. C. in 1973 and W. C. in 1974. Most of the parallels that appear in the following report were collected by W. C. and most of the discussion is his.

Greco–Italic Amphoras (Type I)

L 12*, 5/71 (figs. 79 *c*, 80 *b*) (*IJNA* 2, fig. 14, 2; *IJNA* 3 no. 1). Amphora of Hellenistic shape, complete except for peg. Pres. ht. 0.515 m. Ext. rim diam. 0.16 m. The neck is joined to the body by a slightly swollen, irregular ridge. The upper part of the neck is separately made, and there is a distinct joint-line on the exterior. At the base of the neck and on the shoulder there are a number of shallow, scored lines. The handles are finger-smoothed on to the body. The lip slopes obliquely outwards. The fabric is within the grey-buff range, porous with large irregular inclusions. There is a mid-grey slip, with scattered micaceous grits.

Very close is an amphora of unknown provenance in a private collection in Viterbo (P. G. Guzzo, *La Collezione di Antichità Antinelli*..., in *AC* XXIII, 1971, p. 250 no. 23, pl. LXVII, 2) described as of brown clay. Another closely comparable amphora comes from the « tomb of the silenos » at Sovana (*NSc* XXV, 1971, p. 83, figs. 37–8) a tomb for which a *terminus ante quem* in the late 2nd century B. C. is given. It has a similar dimple at the base of the handle. The peg is hollow.

D 29, 46/74 (fig. 80 *a*). A variation with triangular lip-profile. The body is a dusky pink, shading to buff and baked to a dark grey streaky core. The outside shoulder has multiple score marks on different axes and there is a stamp below one of the handles (figs 79 *a*, 80 *a*) — three raised letters can be made out on a recessed oval stamp under the handle and read C. UF. in Latin. Despite the length of the incuse, definite signs that there were other letters do not appear. There is a cross deeply incised on the

Fig. 79. - *a*) SI/46/74; *b*) SI/9/72; *c*) SI/5/71; *d*) SI/80/72; *e*) amphora neck and handle in Palermo Museum, from Lilybaeum.

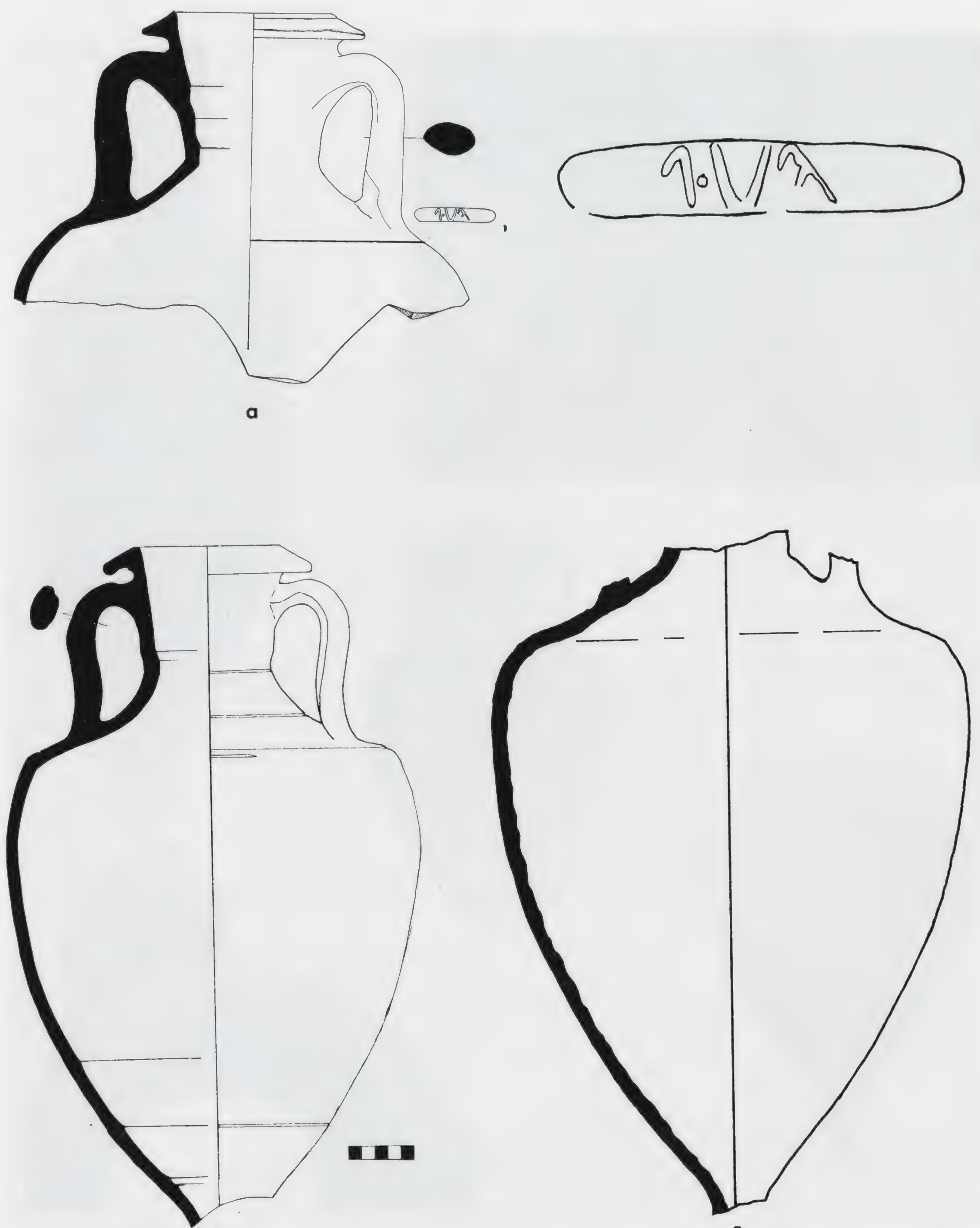


Fig. 80. - *a*) SI/46/74 (1 : 5); *b*) SI/5/71 (1 : 5); *c*) SI/7/71 (1/5).

shoulder. Although this amphora was found between the land block and the north mooring, a large shoulder sherd of identical fabric (017*, 132/72) from the keel cavity confirms its association with the ship.

Associated body sherds: 2/72; 6/74; 14/74; 15/74; 19/74; 20/74; 25/74; 34/74; 66/74; 72/74; 74/74; 76/74; 137/74 (last four from superficial levels at s. side of port ballast); 144/74; 145/74; 149/74; 171/74; 251/74; 278/74.

There are numerous grey-stained body sherds which could have belonged to amphoras of either type 1 or 2: 10/72; 20/72; 26/72; 57/72; 103/72; 105/72, coming mostly from grids M16 and O17; 50/73; 162/73; 163/73; 202/73; M21* 233/73; *237/73 (the last two from under planking); 188/74; 201/74; 202/74; 215/74; 222/74, from grids E31 and G32 and the north side of port E31 and G32 ballast.

No amphora pegs can with certainty be associated with wreck amphoras of this type: see remarks below.

M. Beltran Lloris (*Las anforas romanas en España*, Zaragoza 1970, p. 338 ff.) has surveyed Benoit's original chronology of the Greco-Italic amphora in the west noting additional examples. It appears that the earliest securely datable western context is the Marseilles deposit discussed by F. Benoit (*Typologie et épigraphie amphoriques, les marqes de Sestius*, in *RStLig* 1955, p. 249). where they occur with Rhodian and Cnidian amphoras of 220–180 B. C. and lamps which indicate a date about or after the latter date. Overall, amphoras of this shape appear to have narrowed during the course of the second century. Already the Greco-Italic amphoras of the Grand Congloué wreck beginning about 180 B. C. are narrower. Upper dates for Greco-Italic rims alone are given by the stratigraphy of Ampurias (M. Almagro and N. Lamboglia, *La estratigrafía de Decumano A de Ampurias*, in *Ampurias* XXI, p. 22 ff.) where they probably precede 250 B. C. Beltran (p. 341, fig. 112) gives a form close to Marsala shapes from Ametlla de Mar (Valencia) which he dates to the 2nd century B. C.

These amphoras may be compared with Greco-Italic amphoras from the Grand Congloué wreck (F. Benoit, *L'épave du Grand Congloué à Marseille*, in 14th Supplement to *Gallia* 1961, pp. 36–41), but the neck profile is different and the shoulder somewhat flatter. There is no precise equivalent in these two features, or in the fabric, amongst the amphoras stored at Motya, though there are more globular examples in orange-buff fabric identical to many in Agrigento and Gela Museums. It is therefore most unlikely to be local. In fact, amongst all the published material known to us there is one amphora top – the body is missing—which provides an outstanding comparison. It comes from the coast of Attica from a context dated by coins to the first half of the 3rd century B. C. (E. Vanderpool et al., *Koroni: A Ptolemaic Camp on the East Coast of Attica*, in *Hesperia* 31, 1962, p. 38 pl. 22 no. 44). It is painted with Greek letters, though it is suggested by the authors that in might be Spanish. The fabric is not described, but the stopper with which it is provided is gritty yellow. This context provides the highest date for the shape. Small amphoras from Pennes (Benoit, *ibid.*, Pl. II, 4 and 5) come close both in size, shape, and lip profile, as well as in the amount of space between the top of the handle and the lip. At Pennes they were associated with Rhodian amphoras of the 2nd century B. C. The most precise analogies, however, come from the Porto-Vecchio wreck (A. Tchernia, *Recherches sous-marines* in *Gallia* 27, 1969, pp. 465–99; W. Bebko, *Les épaves antiques du sud de la Corse*, in *Corsica* 1971, pp. 1–3, Pl. XL) for which a date of late 3rd or early 2nd century B. C. is claimed (*ibid.*, p. 6). One of these has a stamp under the handle with letters in archaic Latin. Amphoras similar to those from the Porto-Vecchio wreck are said to have been found around Corsica, in the Bruzzi Islands wreck and in Catoggia Creek (*ibid.*, p. 46). But it should be noted that the Porto-Vecchio amphoras are compared (*ibid.*, p. 6) with the Gela amphoras, but these are in fact more globular in shape. Nevertheless, the grooved neck joint, above which the neck swells out, is a specific connection between the Porto-Vecchio amphoras and is a feature which is also found in rather more globular amphoras from

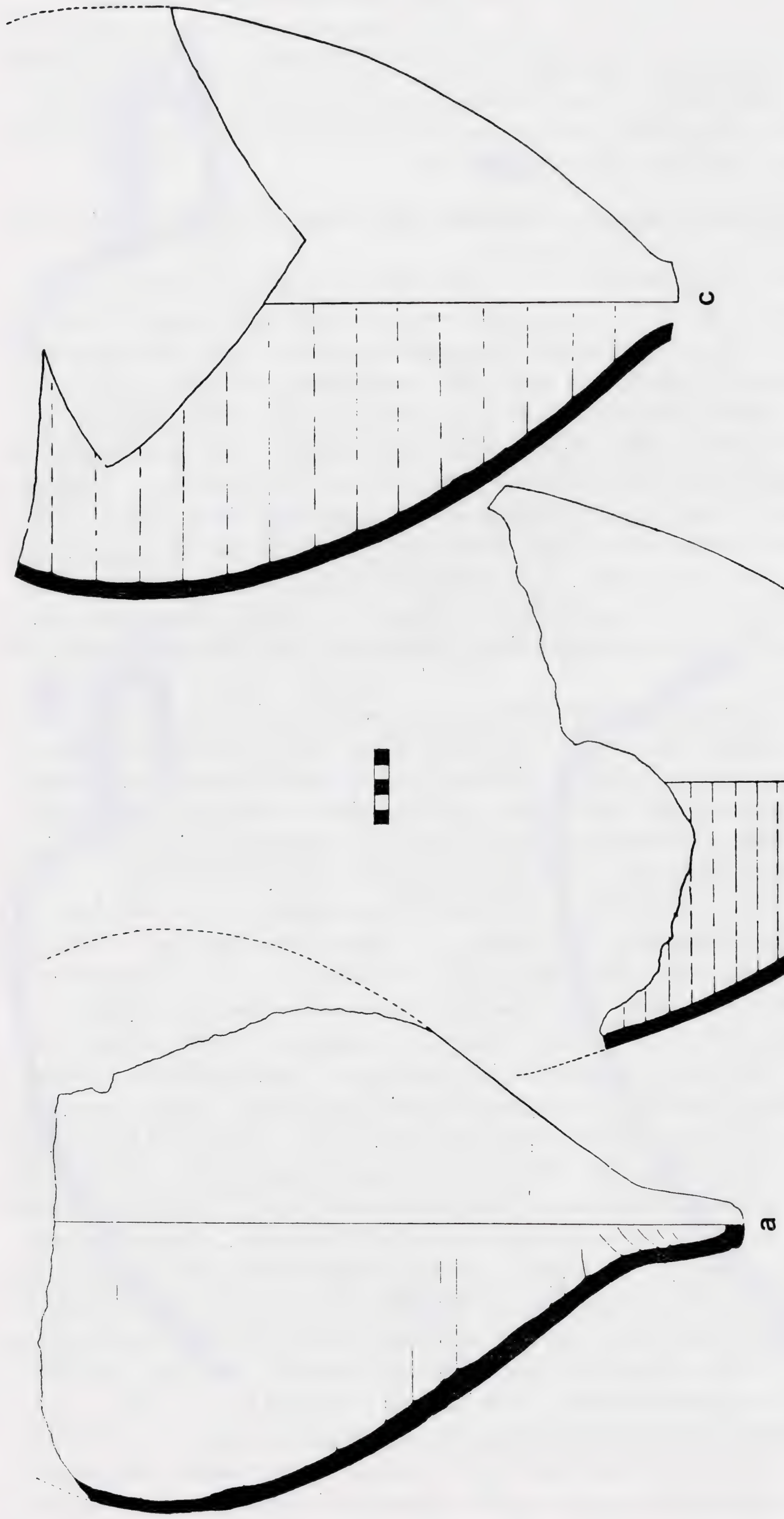


Fig. 81. – *a*) SI/9/72; *b*) SI/21/72; *c*) SI/86/73.

Mellita near Sabratha (A.M. Bisi, *A proposito di alcune anfore puniche di Tripolitania*, in *Studi Magrebini*, 4, 1971, p. 23 Pls. 1, 3; II, 2, and Ead., in *FA* 21, 1966, p. 318 item 4691, Pl. XVII), dated by Miss Bisi to the late 3rd or early 2nd century B.C. Their fabric is described as iron grey. In any case, it appears that the groove at the neck base does not appear before the 3rd century B.C.; one may contrast the 4th century types from Lipari (L. Bernabo-Brea and M. Cavalier, *Meligunis-Lipára* II, Palermo 1975, fig. 14, 98) and Palermo (C.A. di Stefano, *Nuove accessioni al Museo Nazionale di Palermo*, in *Sicilia Archeologica* 12, 1970, p. 30, fig. 9).

Greco–Italic Amphoras (Type 2)

Bodies but no recognizable upper parts were recovered of a further amphora which can be distinguished by fabric as well as its rounder shape. This is ashy grey at the core firing on the surface to a dark bricky red, with a heavy overall filling of black micaceous grits together with larger pebble-like inclusions in various colours. Amongst them are some very scattered large white particles. The peg was hollow and the interior wheel marks are widely spaced becoming close set and spiralling at the base. The outside is mechanically wet-smoothed, though sometimes there is a hand-smoothed slip mixed with black particles, some micaceous. The slip on associated body sherds tends towards a yellowish grey.

L12*7/71 (*IJNA* 3 no. 2) (fig. 80 *c*) (Found with *5/71). Ovoid body of Hellenistic shape. Neck, peg and handles missing. The neck was separated from the body by a pronouncedly swollen shoulder. Fabric light brick-red with scattered, but regular, calcareous particles, and occasional very scattered large white particles.

N16*9/72 (*IJNA* 3 no. 6) (fig. 79 *b*, 81 *a*). Thick, coarse ware, dark grey.

O17 and 18*21/72 (fig. 21 *b*). Made up of several parts found scattered over grids O17 and 18 and inside the keel cavity. The peg has a neatly formed terminal button. The fabric too differs: basically buff with scattered calcareous inclusions. The slip is greyish yellow.

M21 and K14*86/73 (fig. 81 *c*). Made up of several pieces scattered mainly over squares M21 and K14 at "lead level" i.e. under the hull.

This amphora shape appears close to one found in deposits in the Roman Quirinal dating to the 3rd–2nd centuries B.C. (A. M. Colini, *Pozzi e Cisterne*, in *BCom* LXIX, 1941, fig. 3).

"Italian" Amphoras (Type 3)

These are taller than previous types, and although quite obviously derived from Greco-Italian amphoras they mark a turning point in their tradition and clearly anticipate the Dressel IA shape of Italy. The neck has become taller and narrows in the middle. The rim has the oblique overhang of Greco-Italic amphoras but often has a sharply defined and angular ridge beneath it. The handles are hand-pressed into the base of the neck and the juncture sometimes smoothed off by a scalpel. Other distinguishing features are the pronounced ridge at juncture of neck and body with the shoulder sometimes forming a series of horizontal planes. The fabric is always basically a bricky red with a tendency to bake to grey at the core (and always inside the handles). Large quantities of carefully graded micaceous grits have been added to the paste (again anticipating Dressel I A-B fabrics). The outside is slipped a yellowish buff, tending to light grey. Many are lined with resin.

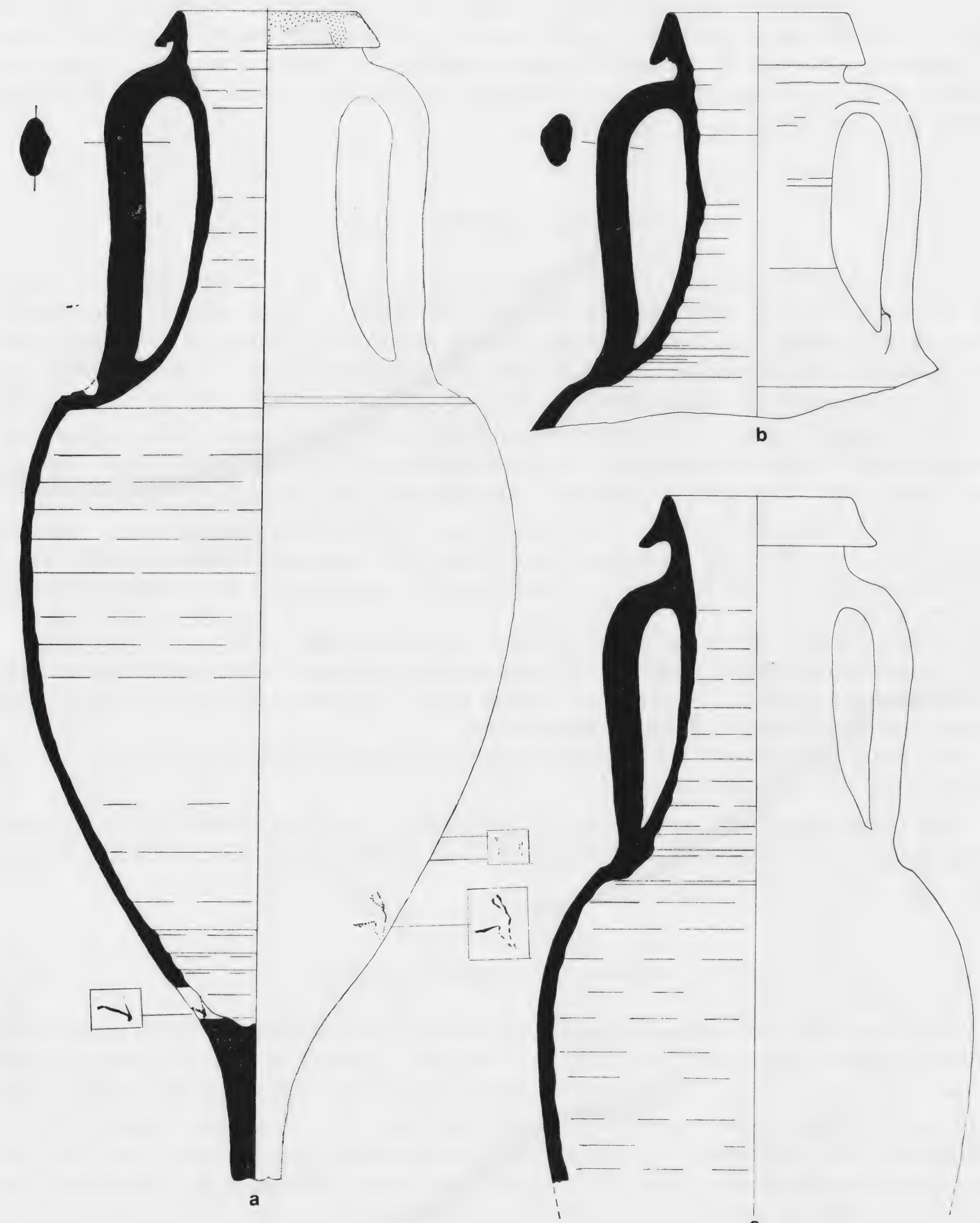


Fig. 82. – *a*) SI/338/74; *b*) SI/80/72; *c*) SI/336/74 (1 : 5).

In addition to those catalogued below, two more amphoras of this type, represented by the upper parts of their bodies only (4/72 and 5/74) and the base of another (37/73) were found in the vicinity of this wreck, but not in contexts definitely associated with it (see *Appendix* II).

3 samples taken from pottery undoubtedly associated with this group (amphora SI/338/74, related body-sherd SI/343/74, amphora from surface S. of wreck SI/24/74) were examined in thin section under the petrological microscope by Dr. D. P. S. Peacock of the Dept. of Archaeology, University of Southampton. He reports that the " three are similar in composition containing abundant particles of well-sorted medium-grained sand. Quartz and cryptocrystalline limestone grains predominate, but there is a plentiful admixture of green and colourless augite, plagioclase felspar and occasionally small fragments of lava. In addition flecks of white mica are scattered throughout... the samples are probably Italian in origin ". They " could well be Sicilian ", and " were certainly in use in 1st century B. C. – 1st century A. D. ".

P15 *336/74 (fig. 82 *c*). Fabric bricky pink in the interior varying to yellowish pink. The surface is light to mid grey with a scatter of shiny black grits.

O17 *80/72 (fig. 82 *b*) (*IJNA* 3, fig. 12:20). Dark grey ware firing to lighter grey on outside with a great number of black inclusions. Slip on outer surface light pink turning grey in colour.

a *b*

Fig. 83. – *a*) SI/308/74; *b*) SI/338/74.

P15 *308/74 (figs. 77, 83 *a*). Certainly from the ship's contents since it lay where the stern had been sandwiched between lead and organic matter from inside the keel cavity). Made up of several pieces. The ware is deep red with multiple grainy grits. The handles baked grey at the core. Thick wiped coat stained grey, but with signs of having been buff red. Many small golden micaceous inclusions.

O 11 *338/74 (figs. 82 *a*, 83 *b*). Reddish grey ware, buff coat. There are a few glass-like inclusions and small white grits with smaller black inclusions.

336/74. Body sherd.

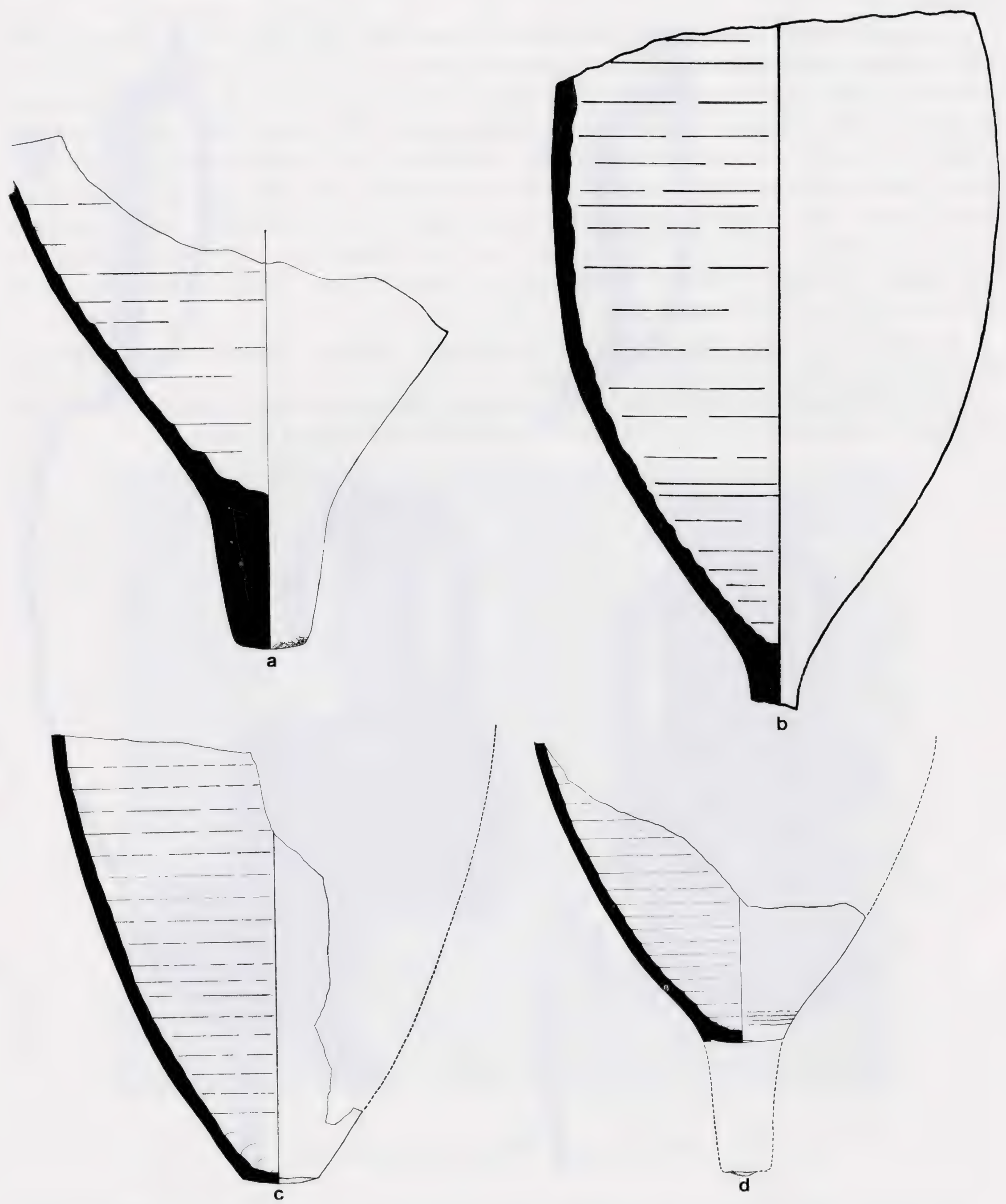


Fig. 84. - *a*) SI/252/74; *b*) SI/43/71; *c*) SI/140/73; *d*) SI/49/72 (1 : 5).

Bases to be classified with them are:

O29 *252/74 (fig. 84 *a*). Brownish grey fabric with white grits.

L. 16, 140/73 (fig. 84 *c*). Mostly fired grey inside with a great number of black inclusions. Slip on outher surface light pink, turning grey.

M and N, 16-20 *49/72 (*IJNA* 3 no. 11) (fig. 84 *d*). Buff with heavy grey staining.

N. 15 *43/71 (*IJNA* 3 no. 5) (fig. 84 *b*). Half amphora under hull, see plan fig. 73. Grey-buff fabric firing to pink in patches with large scattered calcareous inclusions. Light grey slip with pink blush.

Amphora Rims

These are tentatively separated into categories on the basis of fabric.

Greco-Italic Rims:

F. 31 *497/74 (fig. 85 *a*). Greyish brown ware with very few black inclusions. Grey coating.

M. 26 *369/74 (fig. 85 *c*). Dark buff grey ware with multiple white grits.

M. 27 *526/74 (fig. 85 *b*). Dark red ware of " Dressel IB " type with multiple black glassy grits.

Italian Amphora Rims:

O. 18 *25/72 (*IJNA* 3, no. 21) (fig. 85 *d*). Sloped rim with overhanging lip. Belongs to amphoras of this class by fabric, though the neck profile differs.

O. 16 *52/72 (fig. 85 *i*). Inside keel cavity, grey ware.

O. 17 *119/72 (fig. 85 *g*) (on hull). Slight rib on the outside just beneath the lip.

G. 32 *57/74 (fig. 85 *e*). Fabric a gritty orange rather than red.

194/74; 210/74; 278/74 belong to rims of the above shapes.

One rim appears to belong to amphoras of different shape:

O. 15 *40/71 (*IJNA* 2, fig. 14, 5; *IJNA* 3 no. 18) (between ribs 17 and 18) (fig. 85 *l*). Overhanging rim with slightly concave profile and concealed ridge beneath. Well purified clay with large irregular black inclusions. Fabric grey-white with a pink blush, wet-smoothed.

M. 20 *104/72 (fig. 85 *f*). Between ribs 38 and 39 on hull.

F. 32 *136/74 (fig. 85 *h*).

Several of the rims can be paralleled in Stratum B 3-4 at Albintimilium (N. Lamboglia, *Sulla cronologia etc. cit.*, in *RStLig* XXI, 1955, pp. 252-3, figs. 8-9) dated to the first half of the 2nd century B.C. Other parallels are found on the amphoras of Sestius (F. Benoit, *Typologie et épigraphie etc. cit.*, in *RStLig* XXIII, 1957, p. 272, fig. 19). The more concave profile of 119/72 may be compared with amphoras of about 200 B.C. from Tyndaris in Sicily (N. Lamboglia, *La Nave Romana di Albenga*, in *RStLig* XVIII, 1952, p. 162, fig. 20). Less oblique rims with wavy profile like 104/72 are paralleled in Stratum 2 at Les Andalouses, Oran (G. Vuillemot, *Reconnaissances aux échelles puniques d'Oranie*, Autun 1965, p. 235, fig. 97, 5) in a context dated by the presence of Iberian pottery of a type dated by Lamboglia to the 180-140 B.C. date-range (N. Lamboglia, *La ceramica Iberica negli strati di Albintimilium e nel territorio Ligure e Tirrenico*, in *RStLig* XX, 1955, pp. 81-125).

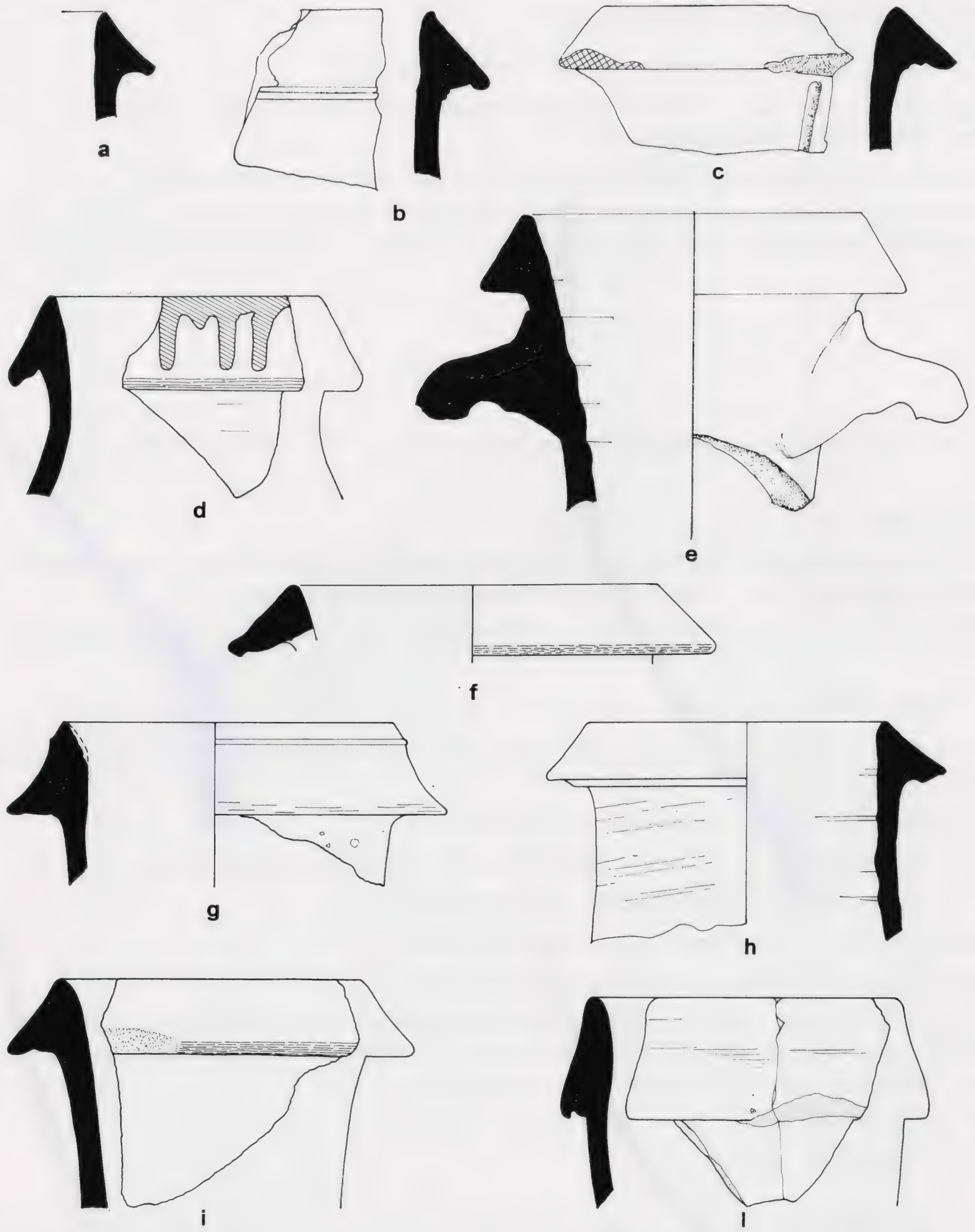


Fig. 85. – *a*) SI/497/74; *b*) SI/526/74; *c*) SI/369/74; *d*) SI/25/72; *e*) SI/57/74; *f*) SI/104/72; *g*) SI/119/72; *h*) SI/136/74; *i*) SI/52/72; *l*) SI/40/71 (1 : 3).

Amphora Handles

Almost all handles recovered are from Type 3 amphoras.

O. 16 *14/71. Under ballast stones.
O. 16 *24/71. Beneath ribs 19 and 20.
O. 16 *50/71 (fig. 86 *c*). Immediately to east of rib 18.
O. 16 *108/71

4/72; P23*13/72; N20*35/72; O16*47/72; P.17*58/72; N18*193/73 (fig. 86 *p*) (with incised cross and curved line. For William Johnstone's interpretations of the signs see p. 190); 87/72.

O.17*116/72 (fig. 86 *d*); *134/72; N 15*149/72.

*3/73; 4/73; 6/73; 17/72; 61/74; 69/73; 100/73; 128/73; 134/73 under port ballast towards " Kitchen Area I " 148/72; 193/73; 198/73; lead level east of N. 21 199/73; 215/73; 220/73; 221/73; 261/73.

P. 26*126/74; H. 33*165/74; 198/74; S. 26*257/74; 296/74; P 23*297/74; 388/74.

With amphoras of this type large numbers of solid pegs may be associated (cf. *IJNA* 3, p. 47):

P. 14–15*33/71; 41/71; 54/71; 89/71 (fig. 86 *e*) (all of secure keel-cavity provenance). 14/72; 36/72; 40/72; 41/72 (fig. 86 *r*); 49/72; 51/72; 66/72; 74/72; *76/72 (fig. 86 *g*); 120/72; 135/72 (also keel cavity P. 15).

N and O. 15–16*145/72; 150/72; 153/72; 155/72; 114/73; 115/73; 197/73; 207–212/73; 210/73; 214/73; 215/73 (all found under planking); 219/73; 243/73; 294/73.

Almost all the above examples are in a compact clay with black micaceous additions and a few white calcareous grits. Most are completely stained a deep grey, but a few unstained examples show a dark, dusky pink fabric baked to a darker greyish pink on the out-

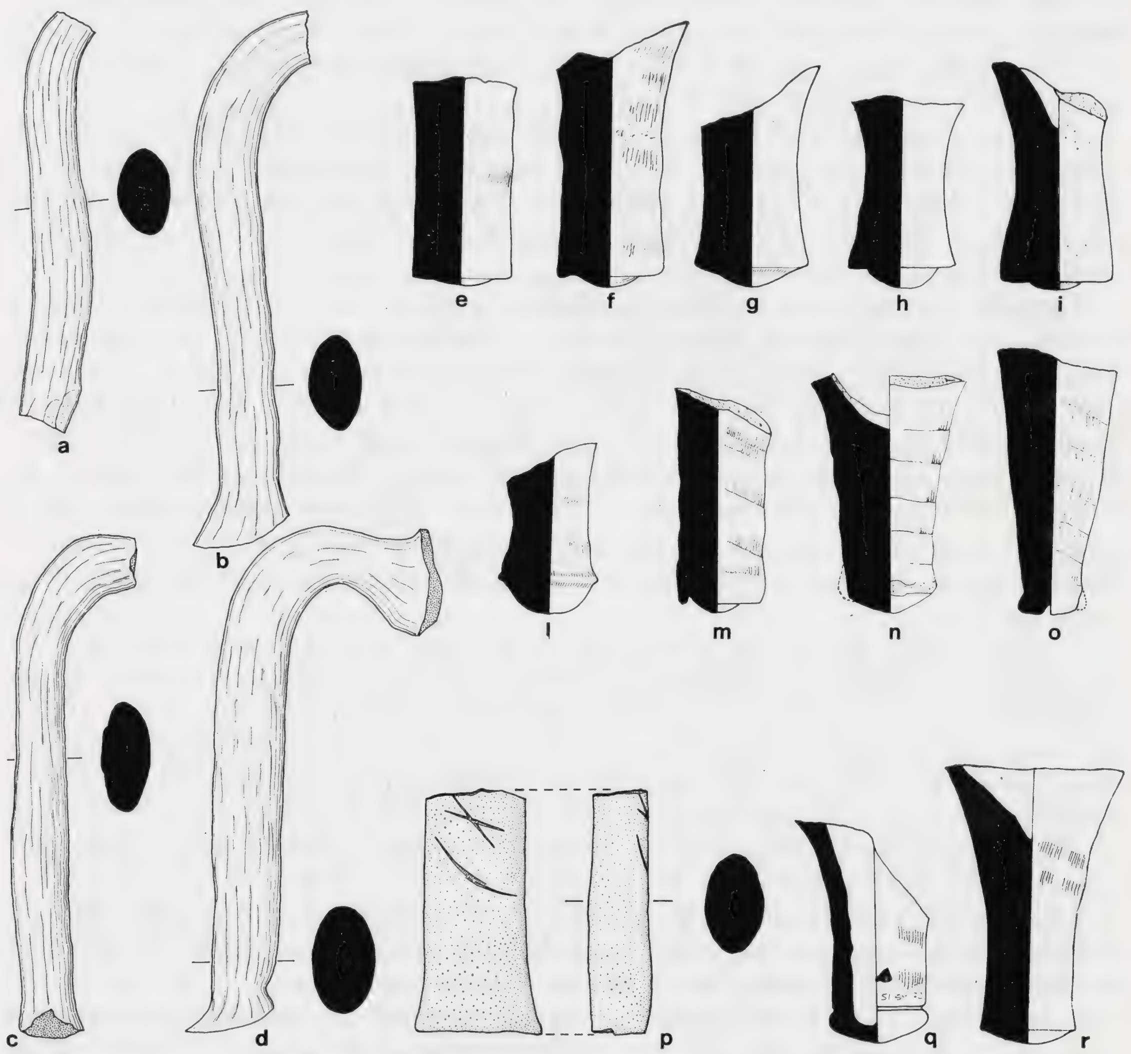


Fig. 86. – *a*) SI/66/72; *b*) SI/19/72; *c*) SI/50/71; *d*) SI/116/72; *e*) SI/89/71; *f*) SI/41/72; *g*) SI/76/72; *h*) SI/508/74; *i*) SI/556/74; *l*) SI/43/72; *m*) SI/517/74; *n*) SI/163/74; *o*) SI/485/74; *p*) SI/193/73; *q*) SI/59/72; *r*) SI/41/72 (1 : 3).

side. There is a smooth outer slip. These are:

O. 24*37–38/72 (" amphora sounding ");

N-O, 15–17*50/72; 143/72; 206/73; (under planks);

I 28, 157–158/74 (landward side of port ballast);

M. 29, 178/74; 199/74; 253/74; 260/74 (starboard ballast);

P. 27*386/74; T. 16 416/74.

It is therefore certain that these pegs represent the commonest amphora found on the ship. They can be associated with certainty with Type 3 rather than Type 2.

The bodies of 43/71 and 338/74 make their association with Type 3 amphoras certain, but not necessarily exclusively so. The staining greatly complicates the problem: nevertheless, a considerable number of pegs appear quite distinctively to have a different texture from that of Type 3 amphoras and incline more to type 1 fabric. It is quite possible therefore that some belong to variant shapes not recovered. 41/71 is quite unrelated to the rest in fabric. The clay is refined and compact, with sparsely distributed large white calcareous additives. It is uniformly fired to a dusky pink colour. The surface has been mechanically smoothed on the wheel and the bottom has a fairly pronounced regular convexity. It narrows swiftly to a column (fig. 86 *r*).

The main characteristic of the peg is the small dome on the inner base, a feature restricted on present evidence to 2nd century B.C. types such as the amphoras from the Anthéor C wreck (Lamboglia, 1961: fig. 1, 376). Exactly similar pegs come from another wreck near Isola Lunga (G. KAPITÄN, *Relitti antichi davanti all'Isola Lunga*, in *Sicilia Archeologica*, 9, 1960, pp. 34–6, fig. 2, left, centre).

The body form is close to Anthéor C amphoras, though the more or less strongly marked shoulder joint inclines towards Dressel IA shape. Further examples from the Cala Rossa wreck at Porto-Vecchio appear to be hybrids between Marsala types I and 3. Two out of six of this type found on the wreck have incised graffiti in archaic Latin at the base of the neck (*Gallia* 33, 2, 1975, p. 604); with them was associated an amphora of Punic type. Especially close are amphoras from the Mont-Rose depot at Marseilles, where almost all the slight variants of Marsala type 3 can be paralleled. They were found together with a Campanian A dish (*ibid.*, p. 583, fig. 14). Other amphoras close in shape come from the Bandol wreck (*A. Tchernia*, in *Gallia* 27, 1969, p. 483, fig. 34) and the Cavalaire wreck (*ibid.*, p. 472, fig. 14).

The body shape of our type 3 amphoras finds a close parallel among amphoras from the Chrétienne C wreck (J.-P. JONCHERAY, *L'Epave " C " de la Chrétienne*, Nice 1975, fig. 34) dated by Joncheray to the second quarter of the second century B.C. (*op. cit.*, p. 111); a coin found in the wreck is dated 211–170 B.C. (*op. cit.*, p. 103). The amphora type is loosely associated to the 3rd–2nd centuries B.C. Although the rim profile is not closely comparable, there being no overhang, the fabric is apparently very similar. It is described (*op. cit.*, p. 79) as being " brun rouge au coeur... l'engobe... est rose ou gris clair, mais le plus souvent jaune pâle ".

In Sicily the Terrasini wreck (V. GIUSTOLISI, *Le navi romane di Terrasini*, 1975, pl. XVII, n. 115) has amphoras with some resemblance in profile to both types 1 and 3 from the wreck. From the Terrasini wreck was yet another variant (*ibid.*, p. 34, pl. XVIII, n. 77) which has a Latin graffito which can scarcely be dated later than the end of the 3rd century B.C. on epigraphic grounds (L. BIVONA, *Rinvenimenti sottomarini nelle acque di Terrasini (Palermo)*, in *Kokalos* XIX, 1973, pp. 201–202). A terminus ante quem for the currency of amphoras of this shape is given by examples from the oppidum of Entremont

taken by the Romans in 125 B.C. and not re-occupied thereafter. Drawings but few details of these were given by Benoit (*Les fouilles d'Entremont*, in *Gallia* 26, 1963, p. 28 fig. 36) who connected some with Sicily on the evidence of their stamps. Also close to wreck types, and indeed providing the closest parallel to the solid pegs with hemispherical bosses so common in the wreck, is an amphora from Epave C at Saint-Raphaël-Anthéor (*Gallia* 31, 1973, pp. 600–3, fig. 34). These had stoppers bearing the name of C. Terren[ti...] and were thus from a Roman source. A coin found in the wreck (*ibid.*, p. 603) has been dated 185–176 B.C.

Of singular value here is a precise comparison which can be made with the upper half of an amphora found in Corinth (O. BRONEER, *Investigations at Corinth 1946–7*, in *Hesperia* 16, 1947, p. 240, pl. LVII, 9). This appears identical in every way with type 3 amphoras and has a stamp on the handle reading *C. CAR* in Latin in a long incuse and in letters comparable to those of "Purg" amphoras. It was found in a closed deposit of Cnidian and Rhodian amphoras dated from the late 3rd to the first half of the 2nd century B.C. and thus appears to be the first *certain* Italian amphora in Greece.

Indeed amphoras with oblique rims are represented in the area of Rome and are described as having quartz crystals and mica included in the fabric (P.A. GIANFROTTA et AL., *Scavo nell'area del Teatro Argentina 1968–9*, in *BCom* LXXXI, 1972, pp. 56, 10 fig. 1).

There do not appear to be many examples recorded from Southern Italy though they occur in the stratified Hellenistic material in the Manaccora cave (E. BAUMGARTEL, *The Cave of Manaccora, Monte Gargano*, in *PBSR*, Ns VIII, 1953, fig. 13). But the circulation of amphoras of this general type within the Roman orbit is made perfectly obvious by the rim stamped *MVA* (fig. 79 *e*) in Palermo Museum and two examples in the pottery repository of the Lilybaeum excavations, one stamped *PAP* (fig. 92 *a*) and the other with ink-painted graffiti in Latin (fig 92 *d*). Further inscribed examples from the Lilybaeum excavations are illustrated by Miss A.M. Bisi (A.M. BISI, in *NSc*, XX, 1966, p. 316 fig. 4b, and 1971, figs. 16–17). A neck with a painted titulus in pinkish beige ware comes from 2nd century B.C. Bolsena (J.-M. PAILLER, *Bolsena 1970*, in *MEFR*, 83, 1971, p. 402).

The evidence therefore clearly suggests that we are dealing with northerly relatives of the Syracusan and Gelan amphoras, for these are of a much plumper profile and in any case would be inscribed in Greek.

The circulation of this type of Greco-Italic amphora in the Punic trade sphere is indicated by the deposit at Cabrera in the Balearics (C. VENY and D. CERDA, *Materiales arqueológicos de dos Pecios de la Isla de Cabrera*, in *Trabajos de Prehistoria* 29, 1972, p. 311) where they occur with purely Punic amphoras, and by their occurrence in Punic tombs of the 2nd century B.C. at Vaga in Algeria, (J. and P. ALQUIER, *Tombes phéniciennes à Djidjelli*, in *RA* XXXI, 1930, p. 9, fig. 5).

Body sherds of amphoras of this type are: 26/71 (ballast. between ribs 15 and 16); 126/71; 128/71 (both airlift on keel and SW of FT 21); 87/73; 139/73 (both keel cavity); 114/73; 139/73: 164/73; 165/73; 211/74; 298/74 (both starboard ballast). Other parts: 346-7/74; 387–388/74; 416/74; 446–53/74; 462–463/74; 537/74; 551–571/74; 586/74.

There appears to be a variant fabric occurring in a number of large sherds bricky red inside and covered with a yellowish slip. They are rosin lined: 5/72; 18/72; 55/72; 72/72; 78/72; 92/72; 118/72; 79/73; 216/74 coming from the ballasts, the keel hole and ribs 27–29 and apparently belonging to the same amphora. Other pieces possibly belong but are stained dark grey: 56/72; 65/72; 68/72; 94/72; 117/72; 127/72; 146/72.

The whole subject of 2nd and 3rd century B.C. amphoras in Sicily is obscure. The precise links between the amphoras of Magna Graecia, Etruria and Rome have not been

worked out, though there are some indications that many intermediary types and stages lay between the ' Greco-Italic ' wine amphoras of Sicily and the Dressel IA, IB types of the Latin wine trade. The ' narrowing ' of the Hellenistic amphora shape is not necessarily a Western process, since amphoras close to the shape under discussion come from the agora at Athens (V. GRACE, *Amphoras and the Ancient Wine Trade*, 1961, fig. 38 left) though, as Miss Grace suggests, they may have come to Greece from Italy. But amphoras of pre-Dressel IA shape are rare on the Italian mainland and the place of Sicily in this typology is poorly defined. P. Baldacci (*Importazioni Cisalpine e Produzione Apula*, 19, fig. 6, in *Recherches sur les Amphores Romaines*, Rome 1972) gives an important example from Milan with a Latin stamp PAP on the lip, and takes it to be an example of 3rd century imports, possibly from Sicily. The letters are the same as on the Lilybaeum rim (fig. 92 *a*) mentioned above, except that the two P's are inverted.

Whatever the case, evidence is emerging concerning the ' narrowing ' process of amphora shapes and in it the wreck group is important. All evidence points to Italy for the origin of amphoras of type 3 and clearly they were far flung; and this is further confirmed by petrological examination (see above). Their distribution is clearly wide. At a point in the late 2nd or early 1st century B. C. amphoras were reaching Tamuda which do not fit the Dressel I A–C profiles, whilst being of the same overall shape. These have long, tapering, apparently solid pegs and are described as whitish rose in fabric. They appear to be not unlike the wreck examples (J.-P. CALLU et AL., *Thamusida* I, in *MEFR*, Supp. 2, 1965, p. 98, pl. LXVI, 2). Amphoras from Punic tombs at Villaricos on the Spanish east coast also clearly belong, though their context might be anything between the 3rd century B. C. and 1st A. D. (M. ASTRUC, *La necrópolis de Villaricos*, in *Informes y Memorias* 25, 1951, p. 71, Pl. 37, 3). The closest Spanish examples are from Alicante (BELTRAN LLORIS, *op. cit.*, 344, fig. 121) which are dated to the 2nd century B. C. There appears a further single example recorded from Spain by G. MARTIN and J. SALUDES, *Hallazgos arqueológicos submarinos en la zona del Saler*, in *Archivo de Prehistoria Levantino* 1966, 9, Pl. IIIAa, who compared it to examples from Albintimilium VIB (about 150 B. C.).

" DRESSEL IB " AMPHORAS (1)

F. 21*3/72 (fig. 87 *b*) (*IJNA* 3 no. 19) which lay on the port ballast pile is the only example found anywhere near complete (neck and handles missing). The fabric is a heavy ashy grey clay baking on the outside to a grey or dark pink. The very heavy inclusion of black grits and few white in the slip gives the surface a speckled appearance. There is a groove round the peg near bottom.

(1) *Note on 2 Anomalous finds: Amphora type dressel 1B and dressel 27 or 37* (*by Honor Frost*).

F. 21*3/72 (fig. 87 *b*) (*IJNA* 3, no. 19). *This amphora was found on the sand above the northern slope of the port ballast pile; the stones continued to spread northwards beneath it. Careful examination of the Excavation Log shows other sherds of this fabric* (*most of them waterworn*) *as coming from the surface of the ballast and predominantly from the northern pile.*

Amphoras of the same type mark another wreck which lies some 200 m. seawards and to the north. This site was first noted during the 1970 survey, before the discovery of the Punic wreck in 1971, when Dr. Harold Edgerton of the Massachusetts Institute of Technology visited the expedition. Using his electronic sub-bottom sounder, he recorded a picture of a sizeable, buried wreck-formation beneath the Dressel 1B amphoras. For this reason the site came known as " Edgerton ". A scatter of broken amphoras of this type stretches shorewards in a south easterly direction; some of them might well have been arrested in their passage by the obstruction presented by the Punic wreck.

P, 13*123A/71 (fig. 87 *a*) *is another problem-find*; *it is described as follows by William Culican*: (*IJNA* 3, p. 50, 26) Amphora neck with part of a flat everted rim and vestige of handle. Greenish-yellow friable fabric

In shape, this body is closer to Dressel IB amphoras than to IA (N. LAMBOGLIA, *Sulla cronologia delle anfore romane di età repubblicana* (*II–I secolo a. C.*), in *RStLig* XXI, 1955, 247–8) which, according to Lamboglia did not come into use until the 1st century B. C. The most precise analogy to both body and peg is an amphora in the Campana Museum, Capua (*CVA*, *Italia*, fasc. XLIV, pl. 11 no. 5) which is taken to be Augustan. Whatever the line of evolution of Dressel I amphoras, it seems clear that 3/72 represents a later and more cylindrical stage than the amphoras of Sestius and Dramont A. But already, according to Lamboglia's chronology' a more cylindrical body with wider peg was current in the Ile Maïre C wreck at the turn of the 1st–2nd centuries B. C. (N. LAMBOGLIA, *Cronologia relativa dei relitti romani*, in *Atti del III Congresso Internazionale di Archeologia Sottomarina*, Barcelona 1961, p. 375 fig. 2) and this seems to be confirmed by the stamps on the amphoras of the Cap de l'Estérel wreck (*Gallia* XXVII, 1969, p. 476, fig. 21). The bodies of the Ile Maïre and Estérel wrecks have the shoulder joint less angular than Dressel IA and Tchernia (*ibid.*) has placed the latter late in the IA typology.

A body without neck from the Isola Gallinaria (Albenga) (N. LAMBOGLIA, *La Nave romana di Albenga*, in *RStLig*, XVIII, 1952, fig. 6, no. 3) virtually identical to type 3 body shapes, is described by Lamboglia as: « Anfora repubblicana . . . di profilo e piede chiaramente corrispondenti alla forma Dressel IB, poco più alta e verticale che nel tipo della nave romana di Albenga e probabilmente di poco più antica (fine del II secolo a. C.) ".

The greatest single problem presented by this pottery is the presence of a great number of parts of amphoras in the distinctive pinkish brown fabric of 80/72 filled with black micaceous grits.

Body portions are:

P. 23*11/71; 30/71; 10/72; 25/72 (surface clearance).

N. 14, 129/71; (at point where hull was torn by "modern" anchor; see its broken fluke M 14-15) 67/72; 75/72; 91/72; 114/72; 137/72; 138/72.

L and M, 15–23 157/72; 159/72; 43/73; 91/73; 75-77/73 (clearance operations; central area) 33/73; 27/73; 29/73; 40/73; 43/73; 45/73; 51/73; 60–61/73; 73/73; 77–78/73; 91/73; 116/73; 121/73 (surface; mostly on the ballast, particularly the northern pile).

130/73 (clearance of sandbank from central area) 143/73; 167/73 (port ballast, 167 is a water-worn handle) 255/73; 290/73 (1974 examples came from both port and starboard ballast piles while they were being cleared of sherds, by Mrs. G. Wood prior to the removal of the stones).

9–10/74; 13/74; 40–41/74; 54/74; 68/74; 60–70A/74; 73/74; 91–92/74; 9–8/74; 103–105/74; 111/74; 113/74; 119/74; 132–3/74; 136/74; 138/74; 143/74; 168–9/74; 261/74; 280/74; 283/74; 283/74; 292/74; 304/74; 366–7/74; 373/74.

with white calcareous inclusions and sandy texture, wet-smoothed. It is possibly part of a Dressel 27 or 37 amphora.

Thus it appears considerably later than the rest of the pottery from sealed contexts on the Punic wreck. Nevertheless this neck was itself from a sealed context, having been found in contact with lead and plant material beside the aftermost extremity of the keel. There are two possible explanations (*in addition to the wreck being much later in date*). *It was precisely at this point that a " modern " iron anchor had dragged across the wreck, breaking the 4th starboard strake* (*which lay beside the neck*), *tearing out a section of port planking and dislodging floor-timber 10. The anchor itself then broke, leaving its fluke beside FT 10* (*see figs. 8 and 78 and Plan fig. 73, N. 15*). *It is therefore possible that surface sherds were dragged down into the furrow made by the anchor, but that this furrow was so narrow that it did not affect the sealed conditions to either side of it* (*which would have destroyed the organic matter*). *The less likely alternative is that this much broken neck might belong to another type of amphora that, hitherto, has not been recorded on archaeological sites.*

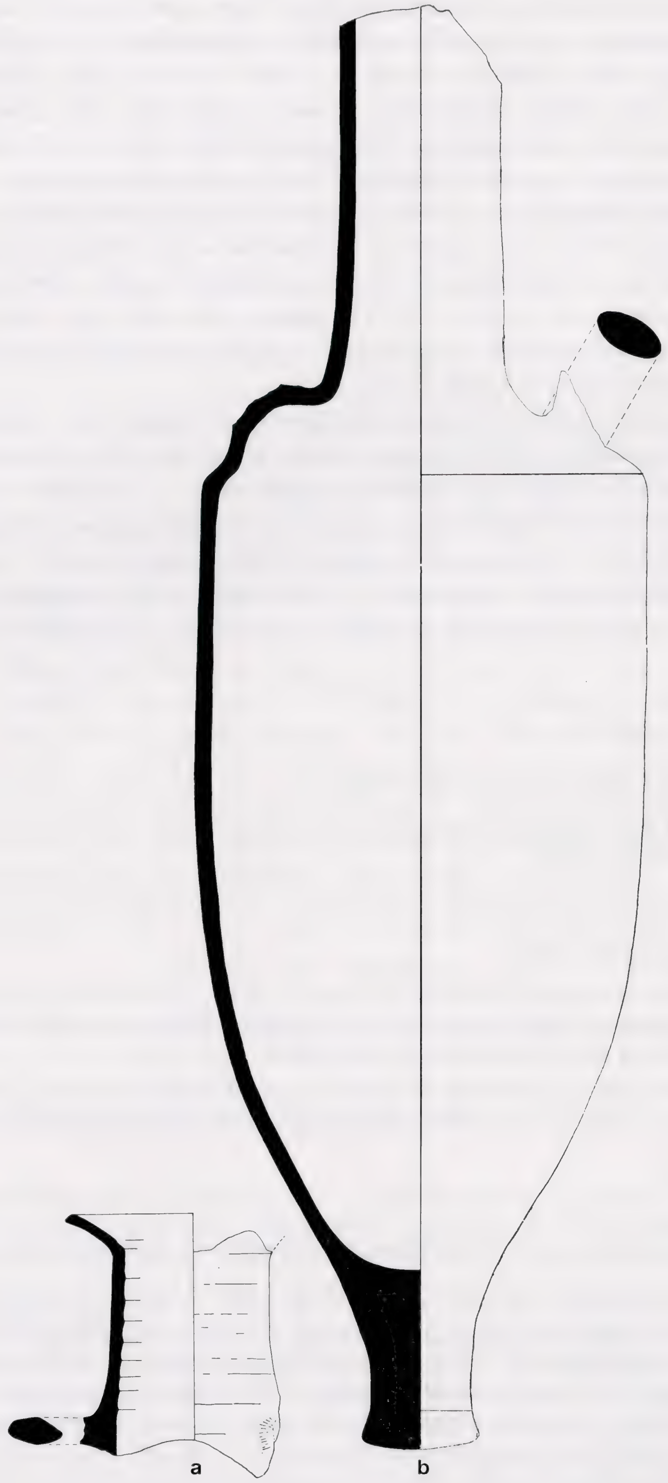


Fig. 87. - SI/123A/71; *b*) SI/3/72 (1 : 5).

Handles are well represented:

P. 23, 8/72; 19/72 (surface).

27/73; (top of starboard ballast). Curiously enough, there are only two pegs - 75/73; 163/74 (both ballast) and two rims 105/74 and 526/74, (fig. 85 *b*) both oblique rims and quite unlike the collared rim usually associated with IB. There is also one bossed peg 508/74 which is in this ware.

The three possibilities are to argue either that these sherds are intrusive (2), or that Dressel IB is much earlier than hitherto proposed; or that we are dealing here with a variant of Dressel IA (usually dated to the 2nd century B. C.) which happens to have the body outline of IB but an earlier rim form. Since no rims of conventional IA or IB type have been found in or near the wreck, it appears that we must adopt the third argument, and perhaps regard the 'Dressel IB' of the wreck as a prototype stage of the Ile Maïre C and Cap de l'Estérel amphoras, since there is no evidence that the wreck examples had developed the taller and less oblique rims of these. Nevertheless, it would be unwarranted to suggest that the wreck examples antedate the 2nd century B. C.

Dressel I (Variant)

Two body and two neck sherds were found, 195/74 (Kitchen Area II) 235/74; 238/74; 239/74 (all Port ballast), of what appears to be a somewhat smaller version of a "Dressel IB" amphora. The ware is brownish red with an admixture of finely ground black and white grits. It is not lined with rosin although there are traces of it on the outside of the neck. The outer surface does not have the same black glassy grits as other Dressel IB ware. Instead, it had remains of a thick slip, now grey.

Punic Amphoras (Type 4)

Amphoras with cylindrical bodies and flaring necks are identified as Punic basically from the fact that some of them originate in the pottery kilns at Carthage (P. Gauckler, *Nécropoles puniques de Carthage*, I, 1915, p. 119 ff) and also because many examples at Carthage and elsewhere have stamps in Punic letters. Their earliest datable occurrence is in the late 4th century B. C. in the Ard el-Kheraïb graves at Carthage (A. Merlin and L. Drappier, *La nécropole punique d'Ard el Kheraïb*, 1909).

The series appears to start with large amphoras with wide flaring necks and low sloping shoulders represented by a single specimen in Motya Museum (J. I. S. Whitaker, *Motya: A Phoenician Colony in Sicily*, 1921, fig. 78) and thereafter to move into a series of complicated rim profiles and to end up in small amphoras with straight upright collars. The elaborate rim profile is found at Athens (V. Grace, *The Canaanite Jar*, in *The Aegean and the Near East: Studies presented to Hetty Goldman* 1956, pl. XII, 2-4, figs. 5-6) and in the Dramont A wreck (F. Benoit, *Recherches sur l'hellénisation du Midi de la Gaule*, 1965, pl. 42) in contexts of the late 2nd and early first centuries B. C. and this date is supported by examples from stratum VIB at Ventimiglia (Beltran Lloris, *op. cit.*, p. 504, fig. 202); but they lasted

(2) *See note p. 158 on the nearby "Edgerton" wreck that is marked by Dressel IB amphoras.*

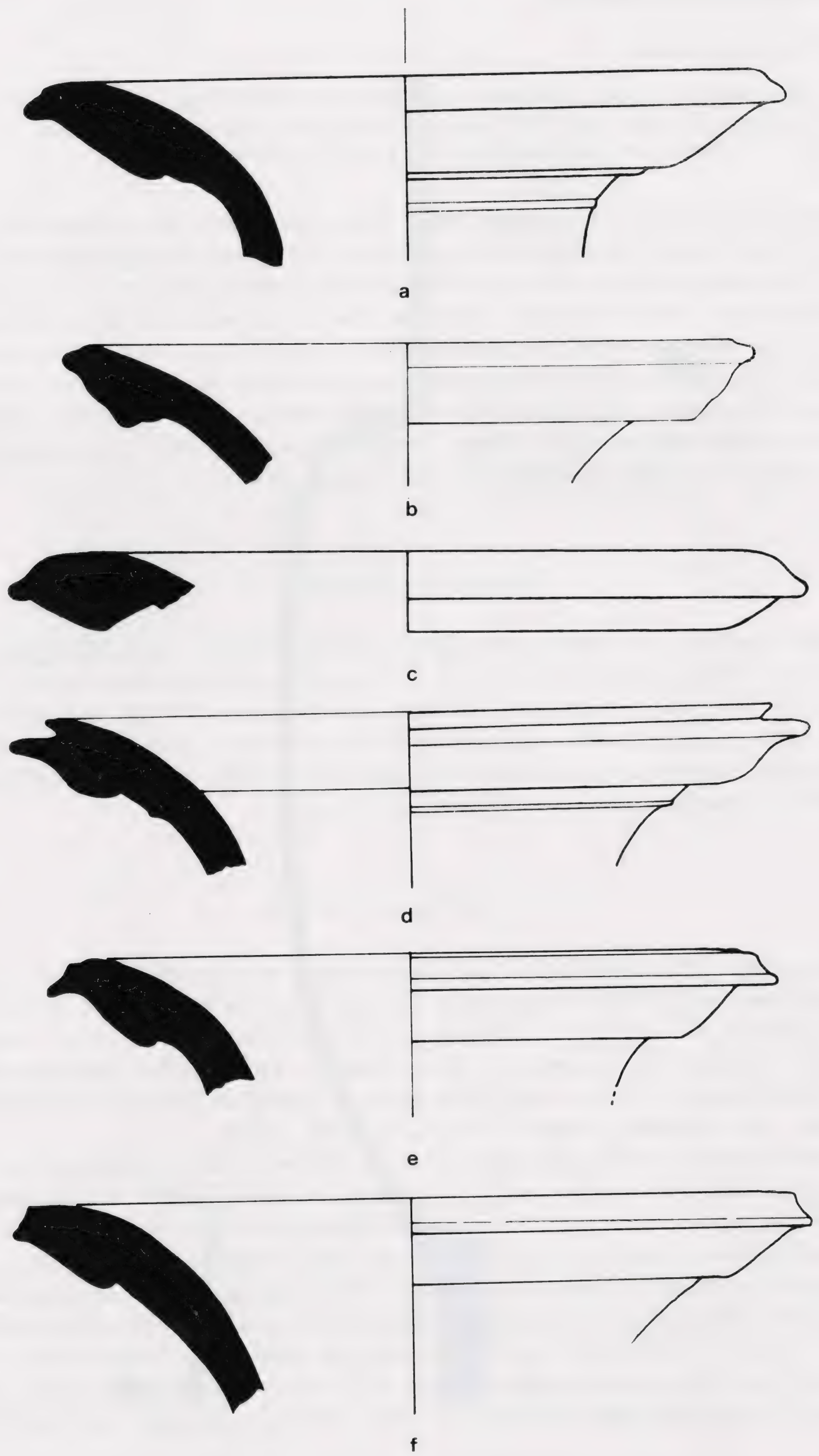


Fig. 88. – *a*) SI/32/71; *b*) SI/140/72; *c*) SI/262/73; *d*) SI/254/74; *e*) SI/415/74; *f*) SI/523/74 (1 : 2).

for a long period elsewhere, probably into Augustan times and show great variety, particularly at Kouass (Tangier).

O. 14* 32/71 (*IJNA* 3, fig. 11: 23) (fig. 88 *a*). Flaring rim made up of three sherds found under floor timbers and in the keel cavity. The rim has a terminal lip beneath which are two mouldings of differing width. The fabric is a whitish grey with a greenish tinge consistently fired and with few inclusions.

M. 20* 140/72 (fig. 88 *b*); (*IJNA* 3, fig. 11: 24). Thick ashy grey ware with a creamy-grey slip. Finely tempered with sparse mica inclusions.

N. 7* 262/73 (fig. 88 *c*). Dark greenish-grey ware with a darker core (brown at centre); white inclusions.

R. 28* 254/74 (fig. 88 *d*). Brown fabric stained grey in parts, probably red originally. Well-made slip, light grey on top, darker below.

R. 16* 415/74 (fig. 88 *e*). Refined consistent fabric stained dark grey. Dusky pink coat with multiple black speckles.

R. 16* 496/74. Neck sherd below rim. Fabric dark red with gritty grey patches; pale grey slip.

Q. 15* 523/74 (fig. 88 *f*). Dark greyish brown fabric with smooth light cream slip.

The thick sherds of these amphoras are distinctive for their solid compact quality and uniformity of firing. A neat distinction can be made in cross-section between the body vessel wall and the slip. Some of the following sherds in this ware have important find-spots, making certain the association of amphoras of this type with the ship:

M. 20* 102/72 (between ribs O-Q); 73/73 (between ribs G-I).

L. 14* 119/73; 124/73; 161/73 (all Port ballast).

N. 27* 227/73 (Kitchen Area I, with fire-wood, basket, etc.).

The wreck profiles are therefore valuable only insomuch as they suggest an upper dating limit of the late third century. 32/71, the clay of which is of fairly standard Punic type, has a profile like that of amphoras (some bearing Punic stamps) used to make a drain in the early second century at Ruscino near Perpignan (*Gallia* XIV, 1956 fig. 1, 207) as well as a stamped neck from Carthage and one from Menorca (M. A. Murray, *Cambrdge University Excavations in Minorca*: *Trapuco*, pt. I, 1932, pl. XL, no 20). But note also its similarity to an example from Belo (Beltran Lloris, *op. cit.*, fig. 202, 10) which is said to be Augustan. It is also close to necks from the Entremont oppidum and from the Ile Verte wreck (Benoit, *Recherches sur l'hellénisation du Midi de la Gaule*, 1965; pl. 42 nos. 1–3) dated to the middle and second half of the 2nd century B.C. The greenish–beige wash of 32/81 is also known on amphoras of this shape at Carthage and has been noted on the Athenian agora examples (Grace, *op. cit.*, p. 109).

140/72 has the blunt-curving profile of the amphora necks from the oppidum at Pennes, abandoned at the end of the 2nd century B.C. (J. Déchellette, *Manuel d'archéologie*, 1927, p. 508 ff., fig. 420: 1–2), and is of the *à tête de cheval* type (M. Ponsich, *Note sur l'industrie de la céramique préromaine en Tingitane*, in *Karthago* XV, 1969, p. 85) from Tangier region.

Amphoras of this type are rare in Sicily: the variants noted by Bisi and Tusa (A.M. Bisi, *Il ruolo di Lilibeo nel quadro della cultura artistica della Sicilia punica*, in *Sicilia archeologica*, I, 1968, 45, fig. 23; Eadem, *La Ceramica punica*, 1970; pl. 27 nos. 2–3; V. Tusa, *I rinvenimenti archeologici sottomarini nella Sicilia nord-occidentale*, in *Atti del III Congresso internazionale di archeologia sottomarina*, Barcelona 1961, p. 264, fig. 1) are all sufficiently different to be classified separately, as are the Punic amphoras of Selinunte (A.M. Bisi, *Anse di anfore con lettere puniche da Selinunte*, in *Oriens Antiquus* VI 1967, pp. 246–257). But local origin cannot be ruled out on yet another count. In the repository

of pottery from the Lilybaeum excavations comes a single amphora (fig. 92 *b*) of a hitherto unique form, though unfortunately incomplete. The neck is of the Punic type, the body not unlike that of amphoras from South Spain (A. J. PARKER, *Evidence of underwater archaeology for Roman trade in W. Mediterranean*, in *Marine Archaeology*, Colston Papers 1973, p. 366, fig. 11). No light can be thrown on the origin of this hybrid, but since only rims survive from the wreck, it cannot be ruled out that they belong to vessels of this type.

The Cala Rossa wreck at Porto-Vecchio, as already noted, was carrying both these Punic and Greco-Italic amphoras (*Gallia* 33, 2, 1975, p. 604, 42) and ink inscriptions and graffiti in Italic on the stamped amphoras from Ruscino, noted above, show that they circulated in Italian ships.

PUNIC 'CIGAR' AMPHORAS (TYPE 5)

This well-known type of Punic amphora is well represented on the wreck, though almost entirely by pieces of amphora walls. There are no complete vessels. They can be recognised by the broad horizontal ribs typical of amphoras of this type and by the vertical shaving of the slip.

Pieces in orange buff fabric:

O. 15* 117/73 (under extremity of stern). Large piece in orange gritty ware, baked grey at core. Buff coating on outside vertically shaved.

O. 19* 201/73 (keel, under lead). Same as above, but thinner.

O. 18* 291/73 (under hull towards port ballast). Orange buff fabric baking to grey inside with multiple large and small white grits, the large ones well-spaced. Grey coat on the outside vertically shaved.

94/74 (Surface stb. ballast). Uniform orange-beige fabric.

K. 29* 212/74. Brownish-grey coating with scattered large white grits. Outside heavily shaved.

S. 27* 266/74. Curving piece towards base of neck. Bricky orange ware baked dark brown at the core. White grits. Traces of brownish buff coating.

K. 29* 270/74. Same as above. Lined with Rosin.

A few pieces have a distinctively redder fabric, with or without grey slip and usually shaved: 371/74; *378/74; *476/74; *491/74; *494/74; *498/74; *513-516/74; *585/74. With the possible exception of 371/74, all are from "sealed" areas.

Brownish-buff fabric, baking light buff on the outside and with regular raised ribs:

R. 19 87/74 (Surface stb. ballast).

O. 14* 126/74 (in plant material). Part of a curved base.

M. 26* 232/74 (trench under port ballast). Very thick buff coating on the outside.

GREY SHAVED WARE

This ware is unusual and the vessels made in it of very large size, perhaps 5 ft. high and 1-1/2 ft. in diameter.

The clay is cindery grey with very fine black and white grits, thin and hard fired to a bright red. Mid-grey matt slip on outside. The clay on the outside has been vertically shaved with large strokes. Inside there are sometimes narrow wheel ridges, clearly set. The inner surface is washed in a greyish brown. Sometimes traces of rosin inside.

Two bases Z, 13* 1/73 and E, 31* 180/74 (like V 21* 522/74 which is not illustrated) (figs. 89 *c-d*), and for comparison a similar example lifted from the "Tile Wreck" (1.50 km to the south) (fig. 89 *e*). The grey slip shades off to a lighter grey zone above the peg, which is red surfaced and has a separate set of regular striations. The pegs are uneven in outline and horizontally turned. E. 31*183A-C/74 ("Kitchen Area" II) and F. 32* 196/74 ("Kitchen Area" II) make up the central part and rounded shoulder of a vessel (fig. 89 *a*) about 36 cm in diam. The thickness of its walls varies from 0.7 to 1.5 cm.

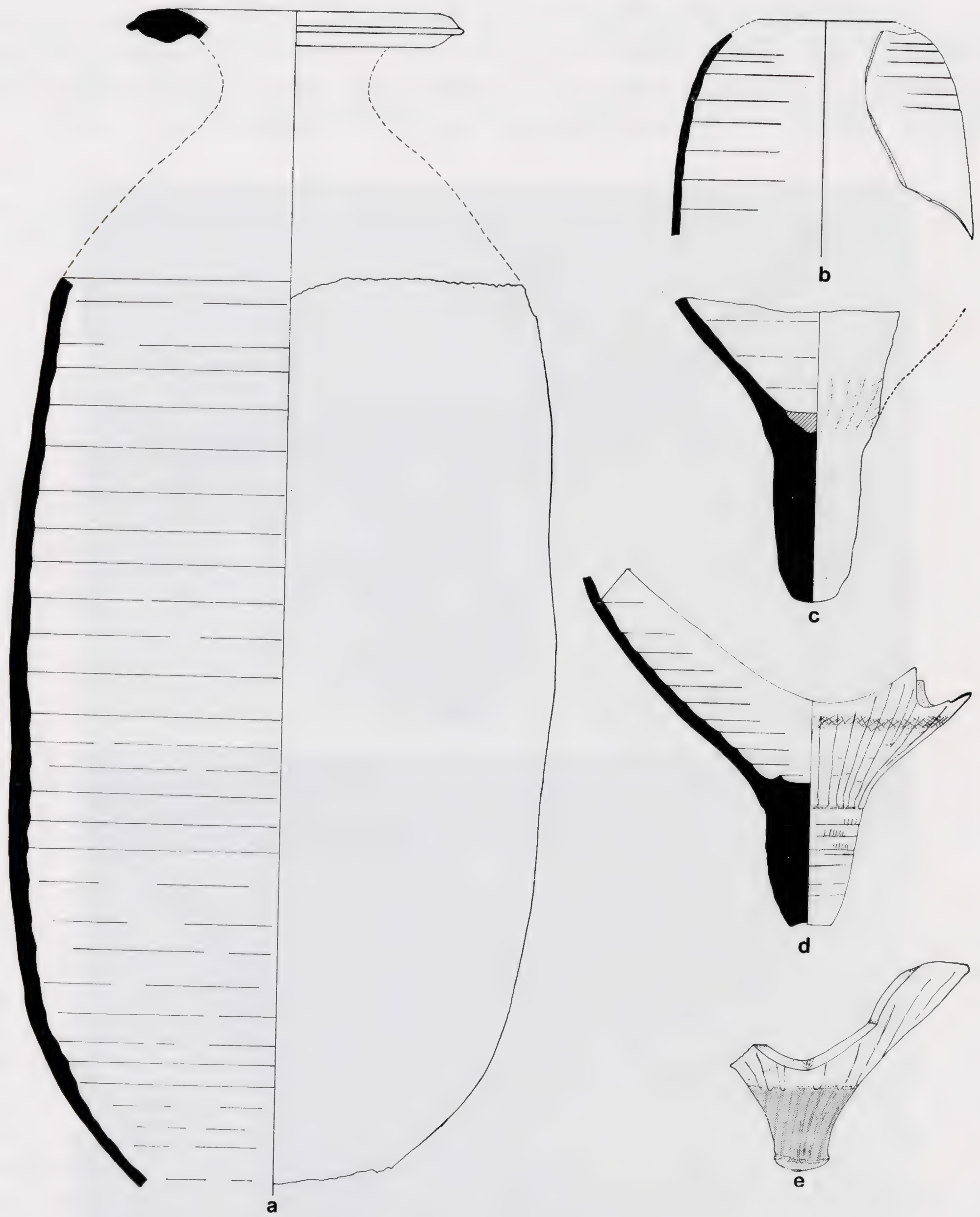


Fig. 89. – *a*) SI/196/74 + SI/262/73; *b*) SI/269/74; *c*) SI/1/73; *d*) SI/180/74; *e*) Tile Wreck (1 : 5).

Body sherds O. 18* 121/72 (under keel): 275/73 (Port ballast).

N. 23* 230/73; 302/73 (in plant material "Kitchen Area I").

M. 15* 137/73 ("Kitchen Area" II) K. 29* 174/74 (trench under port ballast).

G. 31 *213/74 ("Kitchen Area" I): *371/74; *372/74; *425/74 (all "Kitchen Area" II).

A similar sherd: 67/74, was a surface find on the Sister Ship.

Some body sherds of this ware are stained a uniform grey, though sometimes the brown inner surface has resisted staining:

N. 19 *204/73; 232/73 (under planks)
P. 23, 34/72; O. 71 *189/73; M. 20 *248/73
M. 21 *284/73 (Port ballast).

It is not impossible that peg bases of this type belong to North African amphoras of the 3rd century AD, the type studied by F. ZEVI and A. TCHERNIA, *Amphores de Byzacène de Bas Empire*, in *Antiquités Africaines*, 3, 1969, p. 173, some of which appear shaved, especially an example in Malta, *Museum Report*, Valletta 1963 pl. 2.

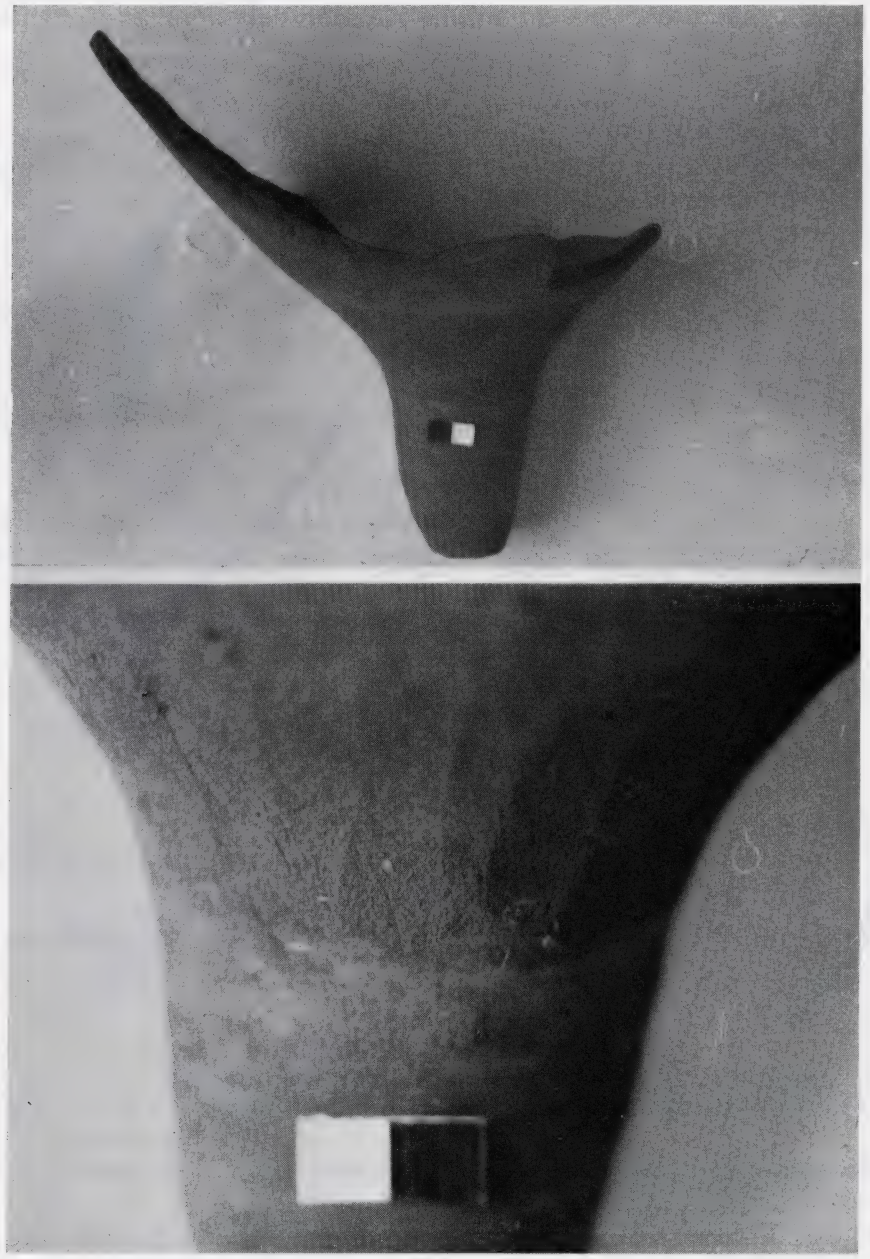


Fig. 90. – Details of shaved peg of SI/180/74.

Thin Wares

There are wall parts in a thinner ware:

O. 15* 42/71 (Between ribs 15 and 17). Soft pink ware with few black grits.

P. 14* 129/71. Soft orange-buff ware with fine white grits (like 42/71) outer grey coat.

G. 32 *207/74 ("Kitchen Area II"). Thin hard-fired orange-buff ware with very fine dark grits and greyish-buff slip on the outside.

M. 20 *269/74 (fig. 89 *b*). Thin sandy brown ware with multiple minute brown grits and scattered larger brown inclusions. Fresh orange pink fabric with grey coating on the outside.

Handles with fragments of wall attaching:

SI/166/73 (fig. 91 *b*). Creamish-yellow fabric with few inclusions, no surface treatment.
SI/236/73 (fig. 91 *a*). Hard, well-fired dark red ware with multiple white grits.
SI/527/74 (fig. 91 *c*).

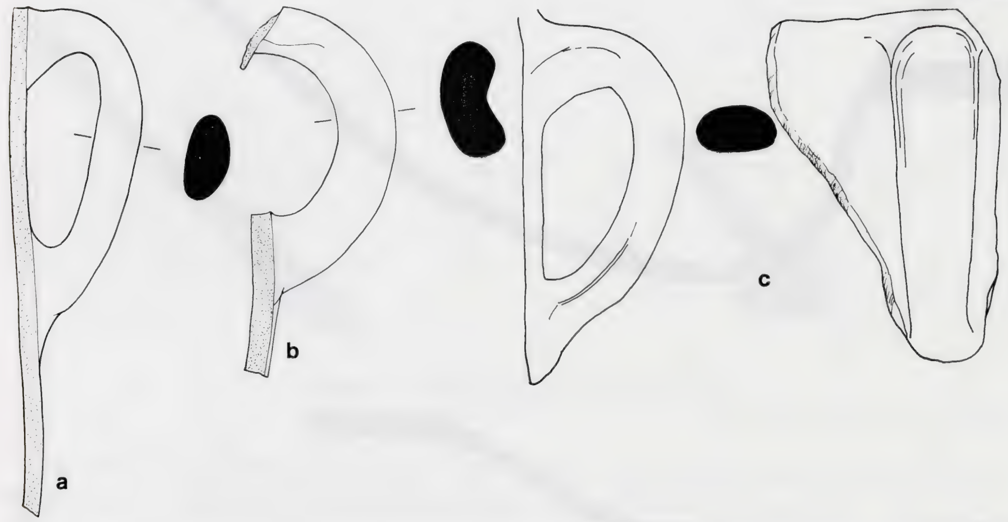


Fig. 91. – *a*) SI/236/73; *b*) SI/166/73; *c*) SI/527/74 (1 : 3).

Cigar amphoras are found in all Punic colonies, though they are rare in Sardinia. There appear to be no recorded mainland examples from either S. France or mainland Italy, though they reached the Sicilian Greek colonies in small numbers. There are many variations in rim and peg. Their initial date in the 4th century B. C. is given by the example from Martí grave 70 at Ampurias, (M. ALMAGRO, *Las necrópolis de Ampurias*, 1953, p. 78), and by the drain in the temple area (G. GANDIA, in *Annuario del Inst. de Estudis Catalans* 1909–1910, p. 107, figs. 5–6) but they continued as a type into the 1st century B. C. (e. g. L. BERTRAND, *La nécropole phénicienne de Stora*, in *BAC* 1901, p. 75 ff.).

The custom of 'shaving' pegs and walls of amphoras, which is distinctive of the wreck group as a whole, does not appear to have been recorded previously. An example of a Type 4 amphora with shaved peg is known to me from Malta (fig. 92 *c*) in the Roman Villa Museum, Rabat, Malta, whilst also the variant of Type 4 noted by Tusa (*loc. cit.*) has a clumsy bulbous hand-moulded peg not unlike that under discussion. There is however no doubt that these bases belonged to very wide amphoras of a size which would be quite out of keeping with Type 4 mouths, and the possibility of a reconstruction like fig. 89 *a* seems unlikely.

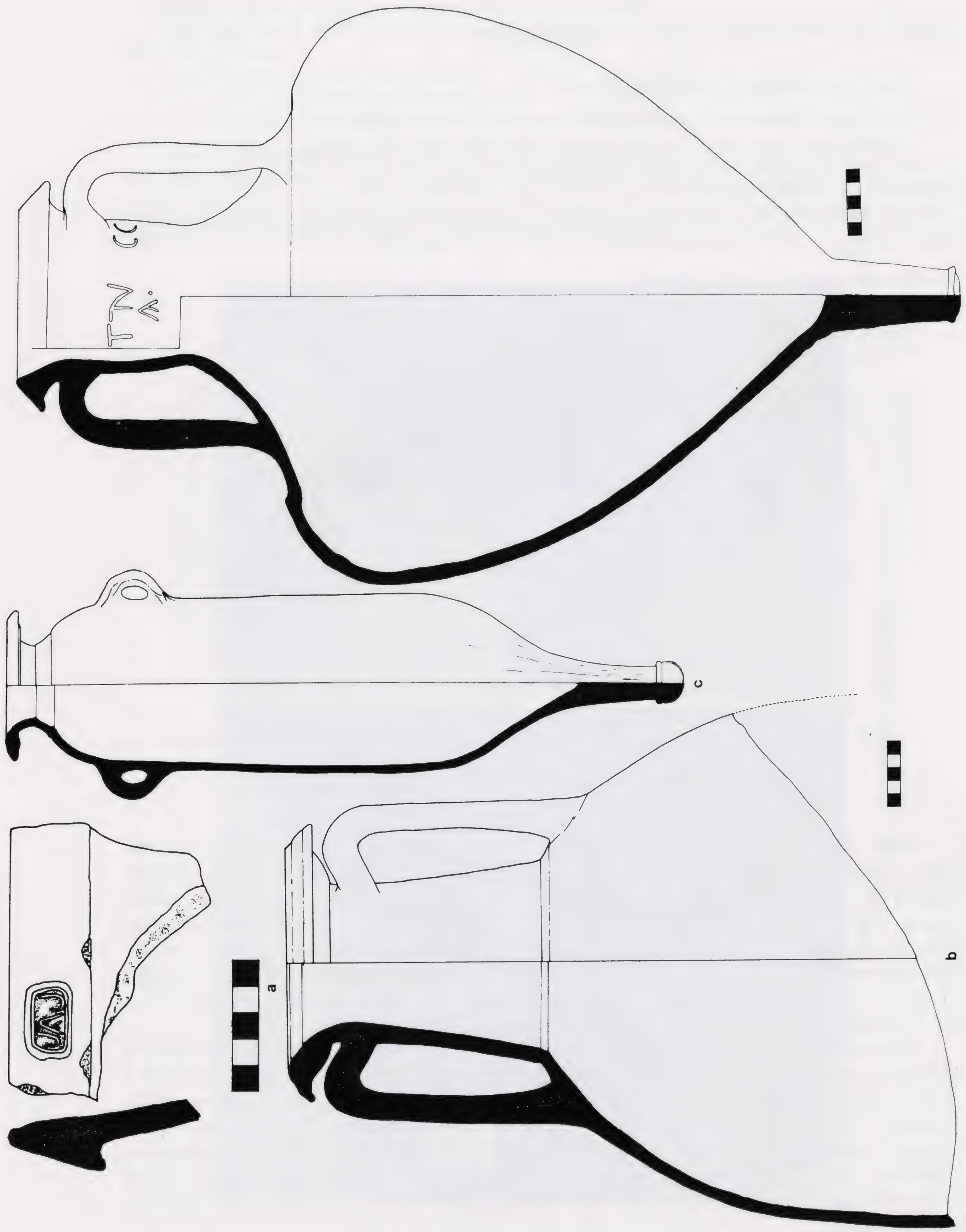


Fig. 92. – *a*) Amphora rim, storeroom of the Lilybaeum excavations, Marsala; *b*) Amphora, storeroom of the Lilybaeum excavations, Marsala; *c*) Punic amphora, Roman Villa Museum, Rabat, Malta; *d*) Amphora with ink inscriptions, storeroom of the Lilybaeum excavations, Marsala.

Thin Amphora Wares

Into this category are collected miscellaneous sherds thinner and finer than normal amphora wares and better made. They appear to belong to small amphoras or large jars. No shapes can be reconstructed.

*175/73. Hard reddish brown sherd 1.75 cm thick. Thick grey mottled slip outside and in.

F. 31 *181/74 (Kitchen Area II). Part of a globular jar of hard-baked grey ware, well purified and baked to a darker grey in the middle of the walls.

279/74 (Starboard side and Port ballast). Shoulder sherd of a small pot with handle attachment. Dark reddish-brown ware with multiple black grits. The inner surface is baked brown, the outer a pearly grey.

481/74. Sherds of bright orange-buff ware finely levigated. Powdery cream slip (probably Punic).

2/71 an oblique shoulder; 148/71; 156/72; 80/73; 135/73; 141/73; 48/74; 89/74; *218/74 ribbed oblique shoulder; *221/74; are sherds of a more metallic ware, hard fired and brownish beige in fabric.

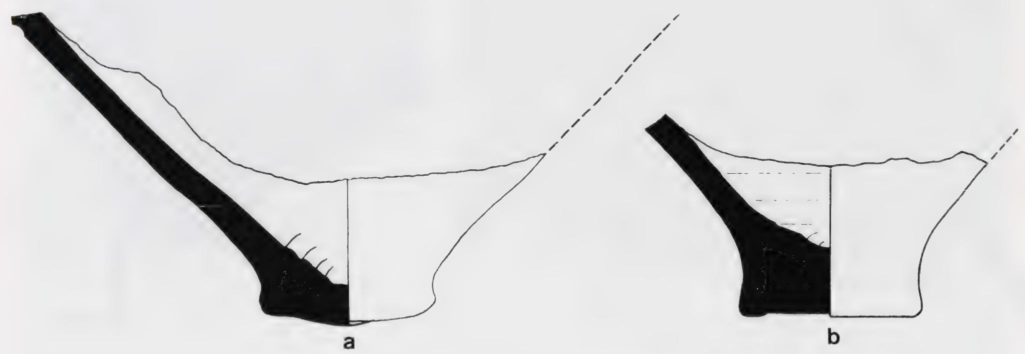


Fig. 93. – *a*) SI/46/72; *b*) SI/147/73 (1 : 2).

Three small rounded bases terminating in small nipples come from the wreck and its vicinity:

*46/72 (Grid 6) (fig. 93 *a*). Sandy brown ware with multiple small soft grey grits.

147/73 (fig. 93 *b*). Well levigated grey ware with a buff tinge in the centre, with multiple white and black grits.

*259/74 (Starboard ballast). Coarse grey ware with multiple black micaceous grits.

Jars and Jar Wares

Under this classification are listed sherds which are too thin to have belonged to amphoras and which generally differ from amphora wares. They appear to have belonged to jars, though very few shapes can be reconstructed.

C. 33 *181/74 (Kitchen Area II) (fig. 94 *a*). Wall with handle of a waisted jar in well purified porous greyish cream ware, partly stained grey. The profile resembles that of a 2nd century B.C. jar from S. Omobono (L. Mercando, *Saggi di Scavo sulla Platea dei Templi Gemelli*, in *BCom* LXXIX, 1963-4, pl. VI, 13) also cream ware.

P. 18, 233/74 (fig. 94 *d*) (Surface stbd. ballast). Wall piece of a waisted vessel in uniform grey ware with yellowish grits. Tinges of pink and deep cream on surface.

G. 21 16/73 (fig. 94 *b*) (Surface port ballast). Flaring rim with ridge beneath in thin coarse ware of grey fabric with large white calcareous inclusions. There is a red slip on both surfaces. Remains of a lug handle. This rim is clearly in the spirit of Sutri rims (*PBSR* XIX, 1964, form 59, fig. 17).

62/73 (fig. 94 *h*) (Surface find) part of the rim of a grey ware with red core and many white and glassy grits.

O. 18 *126/72 (fig. 94 *c*). Rim of a vessel of medium fine ware, buff with cream slip and white inclusions.

95/73 (fig. 94 *g*). Rim of a large pot in coarse yellowish green clay with multiple black inclusions.

L. 27, 287/73 (fig. 94 *e*) (in trench across port ballast). Rim of a large coarse vessel, diam. about 31 cm. Black fabric with micaceous and calcareous additions.

I. 28, 15/73 (fig. 94 *f*). Hollow base, perhaps of a tall flaring jar.

Other fabrics include:

P. 15 *295/74. Buff ware, well purified and smoothed, with a red blush on the outside.

S. 24 *407/74. Thin (2 mm) brown metallic ware, partially stained grey. White grits and grey slip. It appears to have been part of a small globular vessel.

S. 24 *475/74. Sherd of an oblique shoulder, dull grey coarse ware, rosin lined.

S. 23 *510/74. Very thin metallic sherd from a globular vessel. Grey fabric filled with large number of small black and gold micaceous grits.

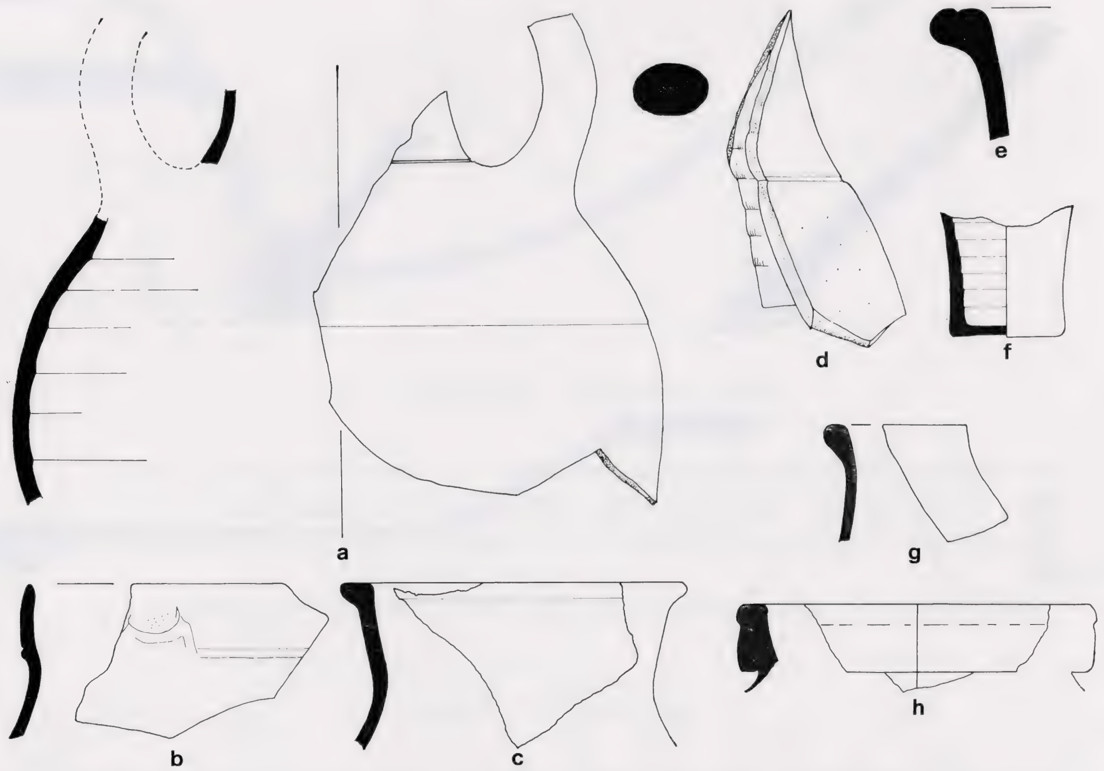


Fig. 94. - *a*) SI/181/74; *b*) SI/16/73; *c*) SI/126/72; *d*) SI/233/74; *e*) SI/287/73; *f*) SI/15/73; *g*) SI/95/73; *h*) SI/62/73 (1 : 3).

O. 21 *531/74. Coarse grey sherd with scattered micaceous grits.

O. 21 *532/74. Fragment of a cylindrical ribbed vessel about 10 cm in diameter. Grey fabric with many scattered black and white micaceous grits.

R. 15 *491/74. Thick (9 mm) hard orange ware with scattered white pebbles, rosin lined. The outside has been heavily scraped before firing.

O. 12 *614-8/74. Fragments of a globular jar in soft friable orange-buff ware with a brown slip on the outside. The clay contains scattered white grits together with small black glittering mica grits.

O. 12 *619/74. Sherd of unusually thick ware of buff grey fabric with multiple black glassy grits.

The small group of sherds 95/73; 247/73; 482/73; 90/74 is highly distinctive. The ware is about 2 mm thick in a hard greyish cream colour with a few scattered black grits. On the outside is a yellowish cream slip closely stippled with black in a ' pepper and salt ' effect.

An unusual fabric in this category deserves special mention. It is thin, grey and flinty, packed with large and small black grits giving a speckled appearance on the surface. The ware is very hard fired and has occasional large pebbly inclusions. At present the surface

Fig. 95. - *a*) SI/93/73; *b*) SI/89/74; *c*) SI/11/72.

has assumed a greenish tint. All three sherds belong to a large globular vessel:

F. 33 *191–2/74; P 15 *290/74.

Q. 20, 89/74 (fig. 95 *b*) also unusual, but because it has been repaired. It is a sherd from a small jar or amphora; the ridging on the inside had been smoothed round the hole into which a cork was then inserted. Blackish fabric with micaceous inclusions, orange to grey on the surface; slight ridging on the outside.

Double-Cordon Handles

Handles of two strands are very typical of Punic pottery, especially in the period of the 4th-2nd centuries B. C. on large jars (P. Cintas, *Céramique punique*, 1950 no. 356). Two examples from the wreck appear, however, more to be amphora handles and no type of Punic amphora with double cordon handles has been recorded. It is noteworthy that the Sutri kiln provided parts of early Roman amphoras with handles of this type (*PBSR* XIX, 1964, p. 50, fig. 6, 21, 23).

M. 26 *260/73 (fig. 96 *b*) (near rope). Gritty fabric stained dark grey.

N. 27 *298/73 (fig. 96 *a*) (Port ballast pile). Grey-buff ware baking to orange-buff exterior. Very fine levigation.

L. 26 *128/74. Fragment of a handle of gritty hard-fired grey ware.

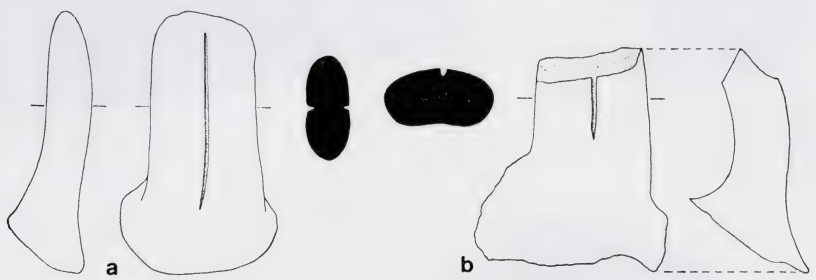


Fig. 96. – *a*) SI/298/73; *b*) SI/260/73 (1 : 3).

Thin Jar Wares

Wares in the range 1–3 mm are probably parts of smaller jars and certainly do not appear from their shape to have belonged to dishes.

L. 27 *411/74. Orange-buff ware with dull black exterior slip.

L. 27 *473/74. Sherd of a globular vessel, grey ware with scattered black and white grits.

O. 24 *531–2/74. Thin compact ware stained grey.

O. 12 *614–8/74. Sherds of an orange-buff globular jar with scattered large white grits and small black micaceous grits.

Coarse Ware Cooking Pots

These are represented by a considerable number of fragments which, unless otherwise stated, are in a typical coarse friable ware, usually black or grey but sometimes a deep brown and usually with the addition of white grits. The original brown colour can be seen on the inside of many examples and both the blackening and crackle on the underside of many

show clearly that they were used on the fire:

O. 11 *621/74. Baked chestnut brown on the inside.

93/73 (figs. 95 *a*, 97 *b*). An almost complete pot made up of sherds found under Port planking, under Port ballast, south of Port ballast and on top of planks 20, 21, 22. Coarse fabric in various shades of orange brown with large white calcareous grits. No surface treatment. Regular wheel marks on interior.

D. 32 *56/74 (fig. 97 *c*).

O. 14 *101/73 (fig. 97 *f*).

K. 29 *184/73 (fig. 97 *e*).

M. 20 *150/73 (fig. 97 *h*). Is inscribed before firing with a sign which William Johnstone has tentatively identified as a *ṣade*.

O. 12 *593/74 (fig. 97 *g*). Ware is distinctly grey and gritty.

I. 29 *159/74 (fig. 97 *i*).

M. 20 *106/72 (fig. 97 *l*).

*69/74 (fig. 97 *m*).

This vessel shape is an old one, used sporadically in Sicily from the 5th century B. C. (I. Tamburello, in *NSc* 1969, p. 286, fig. 19) where it appears to have been a *poculum*. Quite distinct in shape from Punic and Greco-Sicilian cooking pots, it appears to have come into use as a cooking vessel in Italy in the late 6th or 5th century. P. Cintas, *Céramique punique* no. 22 is closest but is a cup rather than a cooking vessel.

The early shapes can be studied in Veii (L. Murray Threipland, *A Semi-Subterranean Etruscan Building in the Casale Pian Roseto, Veii Area*, in *PBSR* XXV, 1970, p. 82 G, H) and seem to belong generally to the coarse ware jar series known elsewhere at Veii (Eadem, *Excavations Beside the North-west Gate at Veii 1957-58*, in *PBSR* XVIII, 1953, p. 53 fig. 14). The continuance of the basic shape into the 4th-3rd centuries B. C. is shown by the contents of a late Etruscan family vault (M. Borda, *Ipogei Gentilizi Tuscolani*, in *BCom* 76, 1958, fig. 31), and thereafter at Savona (in *NSc* XXV, 1971, figs. 54 nos. 5–8 fig. 81) dated tentatively to the second half of the first century B. C. They continued into the late Republic as shown by A. Andrén (*Scavi e Scoperte sull'Acropolis di Ardea*, in *OR* 3, 1962, p. 49 pl. XVI. M4a) whose examples are described as of grey, greyish brown or black clay and where their use as domestic pots is concluded. Thereafter examples which are known from the Sutri Pottery kiln (G. C. Duncan, *A Roman Pottery near Sutri*, in *PBSR* XIX, 1964, fig. 11, form 26) take them into the 1st century A. D.

The evidence therefore points strongly to Northern Italy, and in fact the rim profile of 621/74 is perfectly matched by examples from Veii.

*10/71 (*IJNA* 3. no. 30) (fig. 97 *d*). Makes the connection with Italy certain. In this cooking pot the rim and wall are not in the same alignment suggesting that it is part of a basket-handled vessel in which the rim has been made into a figure—of—eight shape with a handle joining the narrow parts. It is made of friable dark gritty clay with micaceous inclusions and medium-sized white grits. The outer surface is carbonized and well smoothed. This tradition occurs in the coarse cream-wares of the Casale Pian Roseto pottery (*PBSR* XXXV, 1970, fig. 21) and is later found in Roman water jars (*The Athenian Agora*, vol. V, *Pottery of the Roman Period*, pl. 10, J44, 45). It is unknown in Punic pottery except for two examples from Punic tombs in Malta (A. Mayr, *Aus den phönikischen Nekropolen von Malta, Sitzungsbericht der philosophisch-philologischen und der historischen Klasse de K. B. Akademie der Wissenschaften zu München*, 35, 1905, pl. 3) which copy Roman water jars and are definitely not cooking pots.

Sherds of cooking pots of this ware are:

10/71; 25/71; 28/71; 49/71; 55/71;

P. 14 *84/71; *104/71;

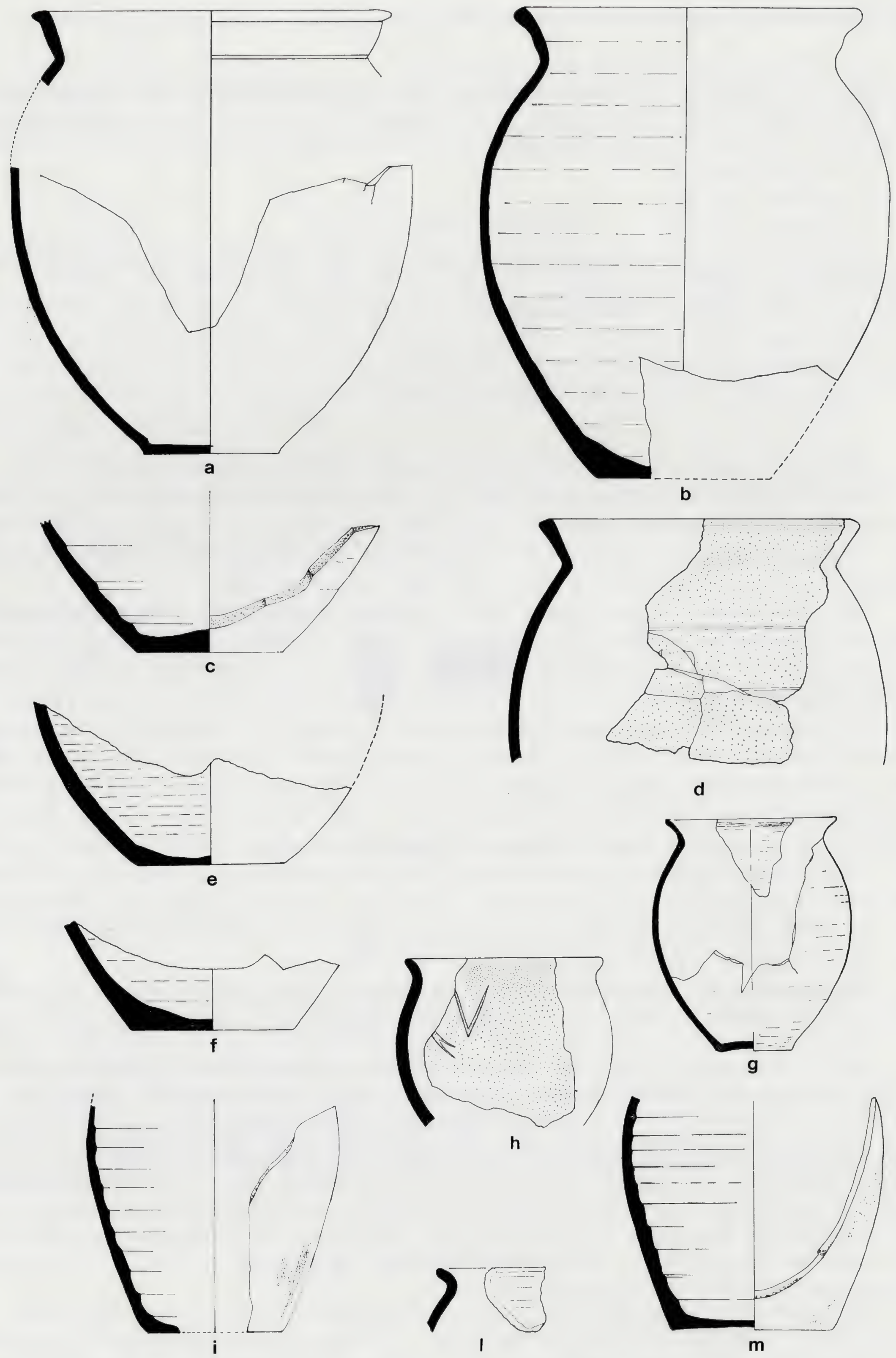


Fig. 97. – *a*) SI/621/74; *b*) SI/93/73; *c*) SI/56/74; *d*) SI/10/71; *e*) SI/184/73; *f*) SI/101/73; *g*) SI/593/74; *h*) SI/150/73; *i*) SI/159/74; *l*) SI/106/72; *m*) SI/69/74 (1 : 3).

P. 23 *12/72; O. 17 63/72; M. 17 65/72; P. 17 71/72; P 17 *88/72; P.18 93/72; N 18* 100/72; 154/72; P. 17 162/72; P. 15 63/73; N 24 258/73; L 24 278/72;

J. 29 160/74; J 29 299/74;

G. 32 *206/74; O 15 *321/74; P 14 *330/74; P 14 *352/74; O 21 *525/74; O 11 589/74; O 11 621/74.

Vessels somewhat similar to those from the wreck were carried on board Epave C de la Chrétienne (JONCHERAY, *op. cit.*, fig. 40, A. D.: fig. 44A) and wreck examples more closely correspond with the group of " urnettes " from the Albenga wreck (LAMBOGLIA, *La Nave Romana di Albenga cit.*, p. 172 ff) so that there can be little doubt that these finds represent the basic kitchen equipment of a ship's cook. Many examples found in Italy bear graffiti, a feature quite unknown on Punic domestic vessels.

COOKING POTS WITH FEATURED RIMS

A number of vessels of this shape (in various wares) have profiles more elaborately moulded than fig. 97.

V. 22 *511/74 (fig. 98 *a*). Dark black friable cooking pot ware, polished on the outer surface. This rim profile is typical of the Italic cooking pots at Casale Pian Roseto (*PBSR* XXV, 1970, fig. 32, 5) and in Latium (L. MERCANDO, *Area Sacra di S. Omobono*, in *BCom* LXXIX, 1966, fig. I, 13).

V. 22 *594/74 (fig. 98 *b*). Dull brown hard-fired ware.

T. 15 *503/74 (fig. 98 *d*). Hard-fired grey-brown gritty ware, sparsely scattered with small white and gold grits. The angles of this rim, whilst not precisely paralleled anywhere, recall rims from S. Omobono (MERCANDO, *loc. cit.*, nos. 3 and 5).

482/73 (fig. 98 *c*). Grey " pepper and salt " ware speckled with cream and black blotches.

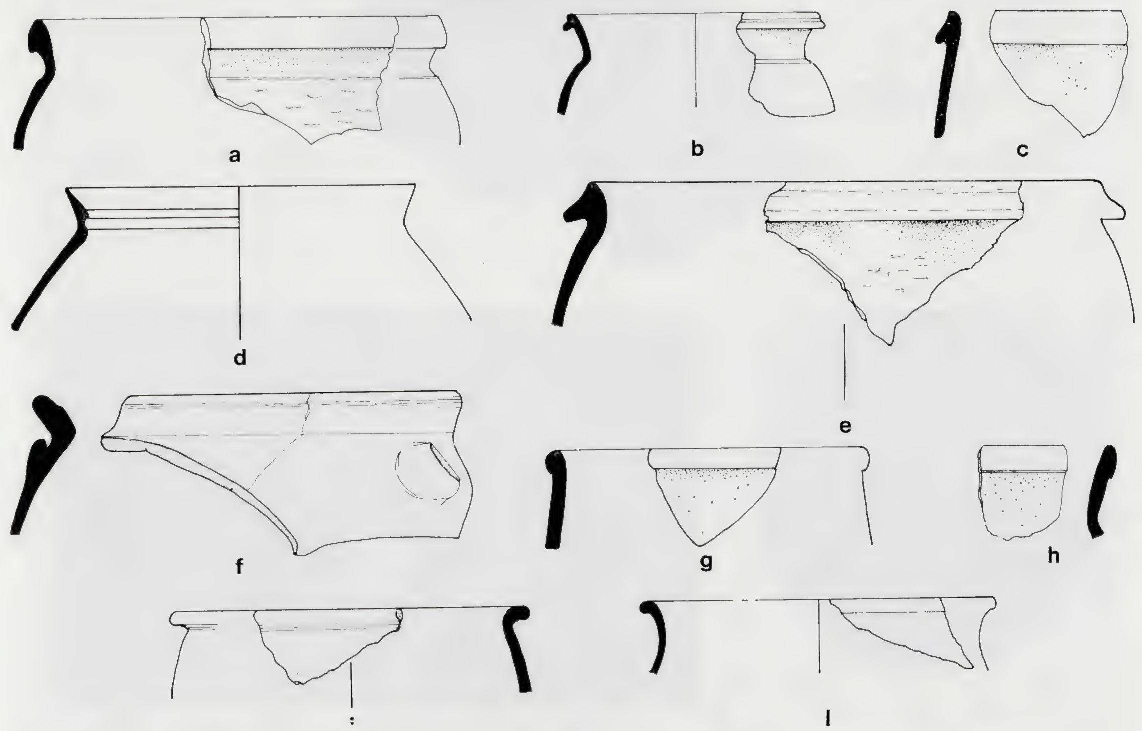


Fig. 98. – *a*) SI/511/74; *b*) SI/594/74; *c*) SI/482/73; *d*) SI/503/74; *e*) SI/385/74; *f*) SI/96/74; *g*) SI/421/74; *h*) SI/217/74; *i*) SI/429/74; *l*) SI/160/72 (1 : 3).

U. 23 *385/74 (fig. 98 *e*). Charcoal black friable ware.

I. 30 *217/74 (fig. 98 *h*). Black friable cooking pot ware, but with smoothed grey surface.

I. 30* 96/74 (figs. 98 *f*; 99 *a*). Part of rim of a round-bottomed casserole of Hellenistic shape in dull greyish brown ware, quite unlike other examples. There is a ridge to take the lid. Cooking pots of this shape were commonly in use in Palermo, Motya and Lilybaeum (P. Marconi, *Rinvenimenti nelle zone archeologiche di Panormo e di Lilibeo* in *NSc* V, 2, 1941, p. 291, fig. 37; J. S. Whitaker, *Motya, A Phoenician Colony in Sicily*, 1921, fig. 76, bottom row centre and right). Their equivalent is found in Hellenistic pottery in Greece (H. H. Thompson, *Two Centuries of Hellenistic Pottery*, in *Hesperia* 3, 1934, p. 466 ff.).

P. 25 *421/74 (fig. 98 *g*). Rim in greyish brown ware with multiple dark brown grits and a few dark yellow grits.

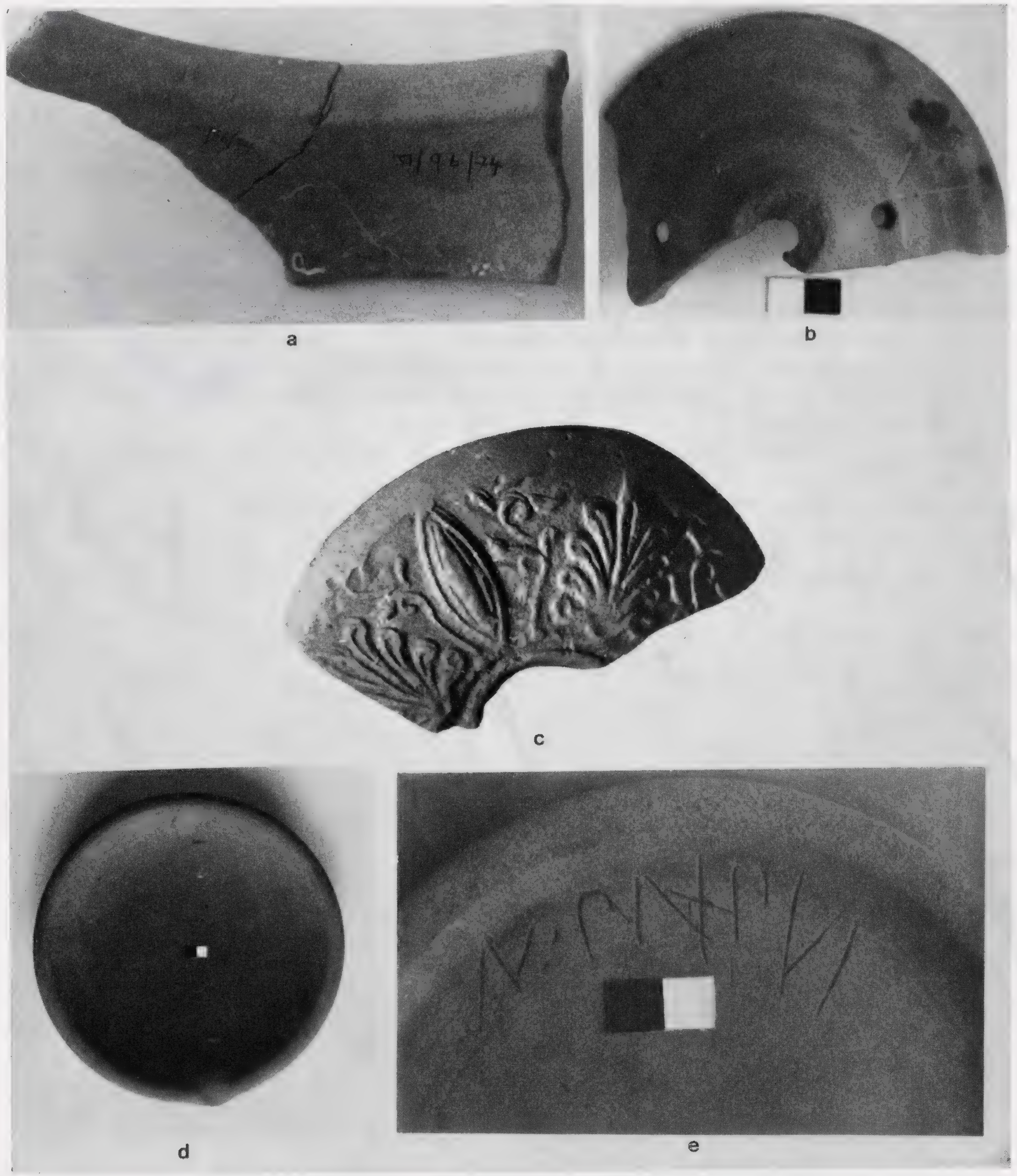


Fig. 99. – *a*) SI/96/74; *b*) SI/55/74; *c*) SI/332/74; *d*) SI/190/74.

P. 25 *429/74 (fig. 98 *i*). Rim in dark brown coarse were stained black. There are two rills under the overturned lip.

M. 19 *160/72 (*IJNA* 3 no. 37) (fig. 98 *l*). The profile here is clearly early Roman, cf. form A52 from Sutri (*PBSR* XX, 1965, fig. 10).

Miscellaneous Handles

F 32 *200/74 (fig. 100 *a*). Part of the shoulder of a jar with handle. Grey stained fabric with gritty, pebbly inclusions.

T 26 *486/74 (fig. 100 *b*). Handle attached to part of a narrow orifice in well-made red-brown hard-fired ware with a medium grey slip.

T 26 *430/74 (fig. 100 *c*). Handle in soft grey paste, possibly the horizontal handle of a cooking pot like fig. 98 *a*.

T 26 *429/74 (fig. 100 *d*). Dark brown ware, refined and soapy with light tan slip well made and smoothed.

R 14 *364/74 (fig. 100 *e*). Ribbed handle in hard gritty grey ware with a greyish cream slip. A comparison comes from stratum III at Veii (I. Pohl, in *NSc* XXVII, 1973, p. 143, fig. 81 no. 83).

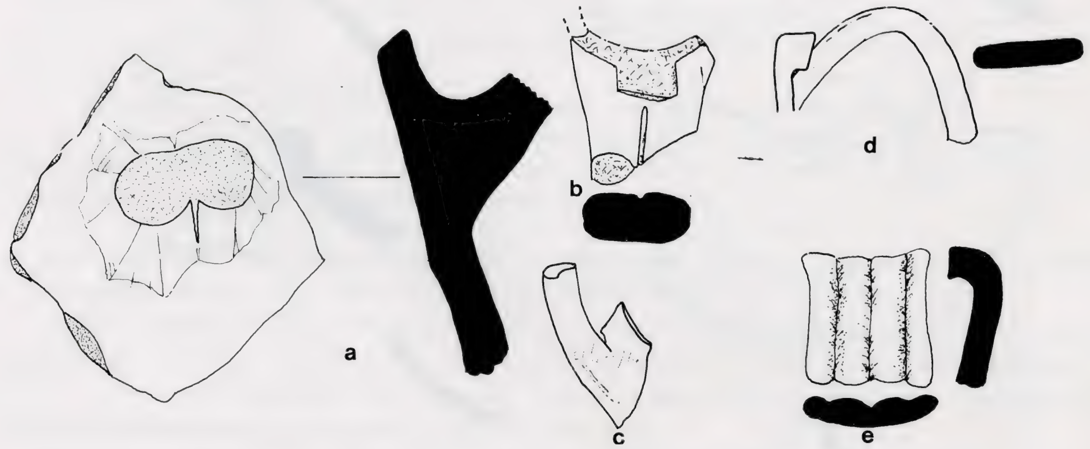


Fig. 100. – *a*) SI/200/74; *b*) SI/486/74; *c*) SI/430/74; *d*) SI/429/74; *e*) SI/364/74 (1 : 2).

Medium fine Cooking Pots

Evidence that these were finer versions of the cooking pots described above is to be found in a number of fabrics. Some fragments like 220/74 are made of the flaky cooking pot ware, though with the addition of well-ground white grits.

217/74 is the same but has a carefully applied grey slip.

159/74 is of light grey porous ware with large and fine black grits. The inside wall is heavily ridged.

258/74 is of nut-brown clay well turned and hard-fired. It is covered inside and out with a matt black slip.

322/74 is in a creamy-pink ware, well fired without slip.

Grey, black or dark brown fragments are:

*143/71; 151/71

*160/72; 30/73; 313/74; 325/74; 327–329/74; 428/74;

*432/74; 434/74; 504–6/74; 512/74; 587–8/74; 590/74 (all from inside keel-cavity or from other sealed areas).

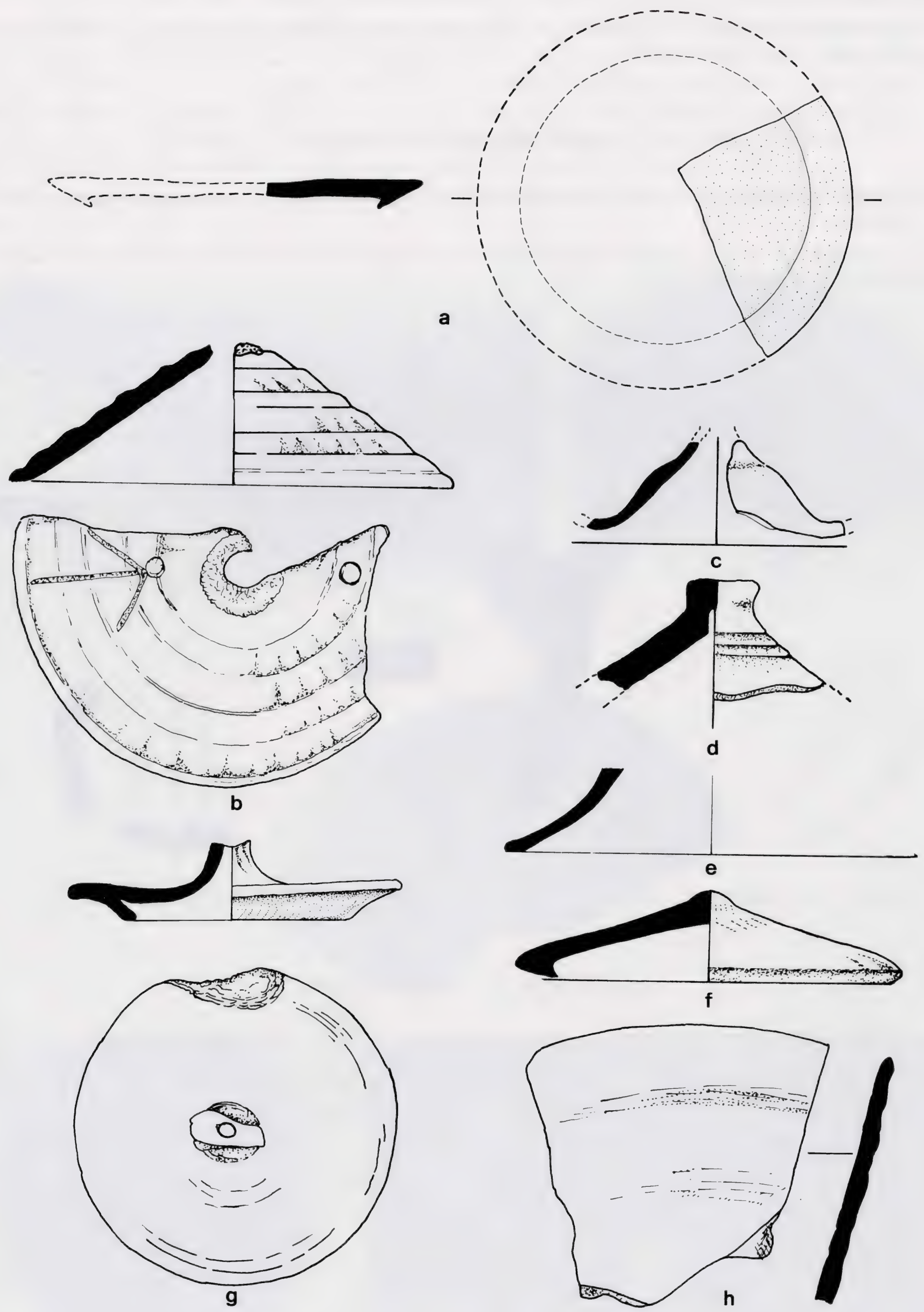


Fig. 101. – *a*) SI/263/73; *b*) SI/55/74; *c*) SI/99/74; *d*) SI/127/74; *e*) SI/220/74; *f*) SI/634/74; *g*) SI/499/74; *h*) SI/490/74 (1 : 2).

Pot Lids

Some of the conical lids are of cooking pot type in the dark friable wares with white grits, like 490/74 and 220/74, but others are rather finer and perhaps belonged to jars.

N. 27* 263/73 (fig. 101 *a*). The fabric, though stained deep grey, is similar to that of Type 4 amphora 262/73 in whose proximity it was found. Quite possibly therefore it was a stopper for amphoras of this type, such as they are known to have sometimes had (F. Benoit, *Recherches sur l'hellénisation du Midi de la Gaule*, 1965, fig. 42, 14).

D. 32* 55/74 (figs. 99 *b*, 101 *b*). Gritty grey ware, mechanically smoothed, with a few scattered white grits. There is a hole drilled through the lid on each side of the knob (broken off) and a carefully incised Italic letter (*kh*) inscribed from one of the holes. This might be an amphora lid like the one with similar holes reported by Broneer (*Investigations at Corinth 1946–7*, in *Hesperia* 16, 1947, p. 240, pl. LVII). But see William Johnstone's alternative interpretation, p. 190.

I. 29* 99/74 (fig. 101 *c*). Dark grey-brown soft fine ware, well levigated and with many white grits, some soft and small, a few large and hard. Traces of cream slip on the inside.

R. 27* 127/74 (fig. 101 *d*). Bricky orange-red ware, much worn.

O. 20 *220/74 (fig. 101 *e*). Small fragment of a lid in cooking pot ware.

T. 25* 490/74 (fig. 101 *h*). Part of a large lid in cooking pot ware. There are gentle concentric rills on the upper part.

T. 25* 499/74 (fig. 101 *g*). Lid of coarse gritty grey ware with re-entrant underside.

N. 11 *634/74 (fig. 101 *f*). Half a lid in dark grey-stained ware with sharply recurved underside. This feature is found in lids from stratum VI B at Ventimiglia of the 3rd century B. C. (F. Benoit, *Gli Scavi di Albintimilium e la cronologia della ceramica Romana*, 1950, fig. 39).

Lids exhibiting the features of those on the wreck have a long-established tradition in Italy going back to the 5th century B. C. (*PBSR* XXV, 1970, fig. 25).

Good parallels to those with hollow knobs can be found amongst the Republican pottery from stratum III at S. Omobono (L. Mercando, in *BCom* LXXIX, nos. 1000, 1569, fig. 8, pl. VI, 10–12) and elsewhere in Rome (M. Polia, *Scavo nell'area del Teatro Argentina*, in *BCom* LXXXI, 1972, p. 98, fig. 8, pl. LXXXIV, 1–6).

Fine Ware

Shallow dishes

115/72 (fig. 102 *a*). (Surface, summit port ballast). Bowl of almost hemispherical shape, not quite intact, of thin grey eggshell ware firing to orange-brown in parts. Outer rim diam. 22 cm. There are scattered micaceous gold flakes and traces of vegetable tempering. The fine everted rim is offset by a double ridge on the interior and in shape is close to rims of beakers. Although a highly refined vessel, the ware is relatively coarse. There are very shallow wheel-made grooves on the upper part of the exterior.

D 31 189/74 ("Kitchen Area" II near inscribed mortar) is a sherd of a similar vessel in dark brown fabric stained black outside. 1 mm thick.

O. 14 *515/74 (fig. 102 *c*). Upper part of bowl in metallic greyish-brown eggshell ware with scattered gold grits.

Stained fragments: 103/73 (Port ballast); 144/73.

It has not been possible to find parallels to these vessels. The nearest in shape, though it is only a rim, comes from Veii from a 2nd century B. C. context (M. Torelli and I. Pohl, in *NSc* XXVII, 1974, no. V 244). The gold grits are significant since they are a noteworthy feature of some Italic pottery (G. C. Duncan, *Roman Pottery from the Vicinity of Sutri*, in *PBSR* XX, 1965, p. 160).

Thin Ware Beakers

These belong to the cups of " céramique à parois mince " which date to the mid-second century at Cosa (M. T. Marabini Moevs, in *MAAR* XXXII, 1973, p. 58 form III, pls. 4, 36; 3, 29). The Sutri deposit has beakers similar to ours (G. C. Duncan, *Roman Pottery from the Vicinity of Sutri*, in *PBSR* XX, 1965, p. 150 form 20) with dates no earlier than the 2nd half of the 2nd century B. C.

At Policoro (*NSc* XXVII, 1973, pp. 144–5, fig. 25, *1–4*), they acquire a red glaze in the 1st century B. C. All the wreck examples, except 186/73, are self-slipped or simply smoothed or brown washed. A brown colour wash is common on hard fired wares from Sutri (*PBSR* XIX, 1964, p. 53).

31/72 (*IJNA* 3, no. 34) (fig. 102 *b*). Sharply everted rim with a groove on the underside at the juncture of neck and body. Grey fabric with wet-smoothed outer surface.

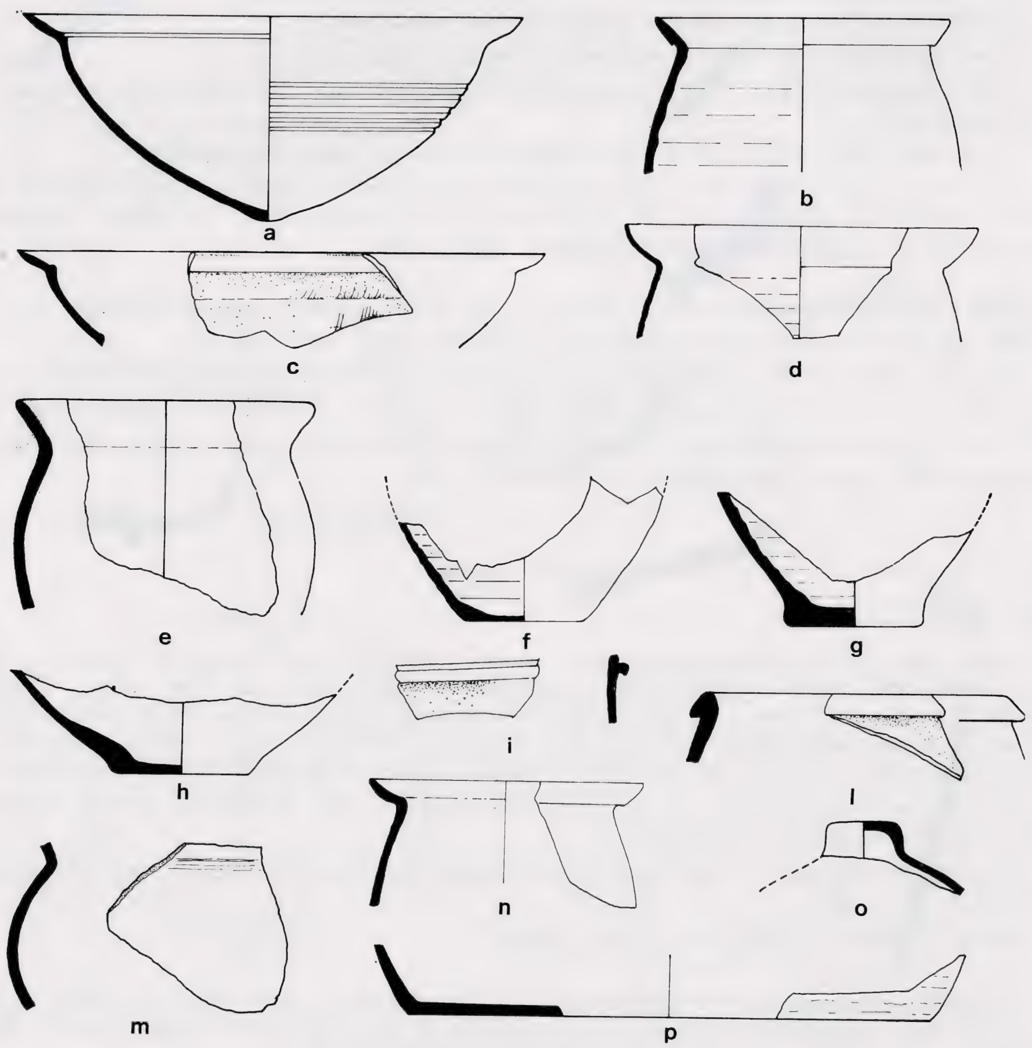


Fig. 102. – *a*) SI/115/72; *b*) SI/31/72; *c*) SI/515/74; *d*) SI/149/73; *e*) SI/196/73; *f*) SI/186/73; *g*) SI/312/73; *h*) SI/190/73; *i*) SI/432/74; *l*) SI/431/74; *m*) SI/88/72; *n*) SI/313/74; *o*) SI/133/72; *p*) SI/166/74 (1 : 2).

M. 20 *149/73 (fig. 102 *d*). Grey ware with greyish-brown slip. Calcareous and micaceous inclusions in slip as well as in fabric. A base 153/73 probably belongs to it.

P 15 *313/74 (fig. 102 *n*). (Keel cavity). Greyish black refined ware.

O 13* 196/73 (fig. 102 *e*) (under hull). Fine ware, pale brown with grey core and white shiny grits.

O 14 *186/73 (fig. 102 *f*) (under hull). Very fine in bricky red ware fired to a brownish red on both surfaces. Sherd 149/73 is similar in fabric but has remains of a cream slip.

P. 23 *312/73 (fig. 102 *g*) (deep sounding where black glazed bowl no. 24/71 had been found). Grey stained fabric with fine white inclusions.

P. 17 *190/73 (fig. 102 *h*). Fine clay with few inclusions.

Q. 22* 431/74 (fig. 102 *i*). Rather coarser ware with turned down rim. Brownish grey fabric with scattered large glossy black grits.

Q. 22 *432/75 (fig. 102 *l*). Beaker rim of eggshell fineness with a down-turned salient beneath the lip. Highly refined dark tan ware baking to pinkish brown, with scattered mica grits.

O. 23 *88/72 (*IJNA* 3 no. 33) (fig. 102 *m*). Shoulder of a rather more globular beaker in dark grey ware with traces of outer brown wash.

R. 14* 166/74 (fig. 102 *p*). A broad flat base in well purified soft light orange-buff ware. Circular score mark in centre of floor.

O. 17 *133/72 (*IJNA* 3 no. 36) (fig. 102 *o*). A lid in fine grey ware, wet-smoothed. Lids were often made for beakers as is shown at Ampurias (M. Almagro, *Las necrópolis de Ampurias*, I, 1953, p. 372).

Other fabrics can be recognised in the related sherds:

Large cream pink ware, sandy: 17/72.

Grey-black pieces: 10/71 (five sherds of a cup from under the ballast pile).

Some of these found in the keel cavity: 31/71; 45/71; 17/72; 88/72; 99/72; 106/72; 103/73; 144/73; 196/73; 312/73; 265/73.

Some of these are brown in parts: 316/74; 324/74; 536-538/74; 543-45/74.

Stained bases and walls: 88/72; 190/73 (both keel cavity). 265/73 (Port ballast).

Sherds from cups in black, brown or grey ware are: 355/74; 409–410/74; 503/74; 535/74; 543/74; 546/74; 591–613/74; 666–5/74.

Black-Glazed Ware

The black-glazed pottery associated with the wreck includes parts of four hemispherical bowls of Campanian A ware, three with graffiti. The type is that of C. N. Lamboglia, *Per una classificazione preliminare della ceramica Campana*, in *Atti del Primo Congresso Internazionale di Studi Liguri*, Bordighera 1952, pp. 139–206).

O. 16 *24/71 and Q 24* 272/74 (fig. 103 *a*). Hemispherical footed dish in deep greyish buff ware with central rosette stamp. Inscribed after firing with letters P. C.

P. 23. 11/72 (*IJNA* 3 no. 41) (figs. 95 *c*, 103 *b*). The graffiti were originally interpreted as Punic even though the archaic nature of the *šin* on the exterior caused difficulty. Now that the upper graffito has been completed it seems more satisfactory to regard it as Italic *C–A* and the graffito on the outer base as an Italic *Kh*. The length of the strokes themselves points to an Italic rather than a Punic hand. (*But see William Johnstone's comments on the aggregate of the graffiti on pottery at the end of this chapter, page 189 H. F.*). A similar sign is on the base of a bowl at Casale Pian Roseto (*PSBR* XXV, 1970, fig. 25, B 3).

Q. 20 *293/74 (fig. 103 *c*). Rim sherd of a dish with slight inner keel. The exterior graffito might well be two points of a five pointed star as appears on vessels at Casale Pian Roseto (*PBSR* XXV, 1970, figs. 3, 4, 5). The interior graffito resembles W with all strokes made from the top downwards as in the graffito on the pot rim (*ibid.*, fig. 27 G, 23).

P. 23* 24/72 (*IJNA* 3, no. 40) (fig. 103 *e*) (Amphora hole). Light porous clay.

R. 20 *130/74 (fig. 103 *g*). Rim sherd of pinkish buff ware with black glaze much worn.

O. 12, 116/74. Rim of a finely made cup in pure pinkish brown clay. Thick matt black glaze faceted horizontally on the outside.

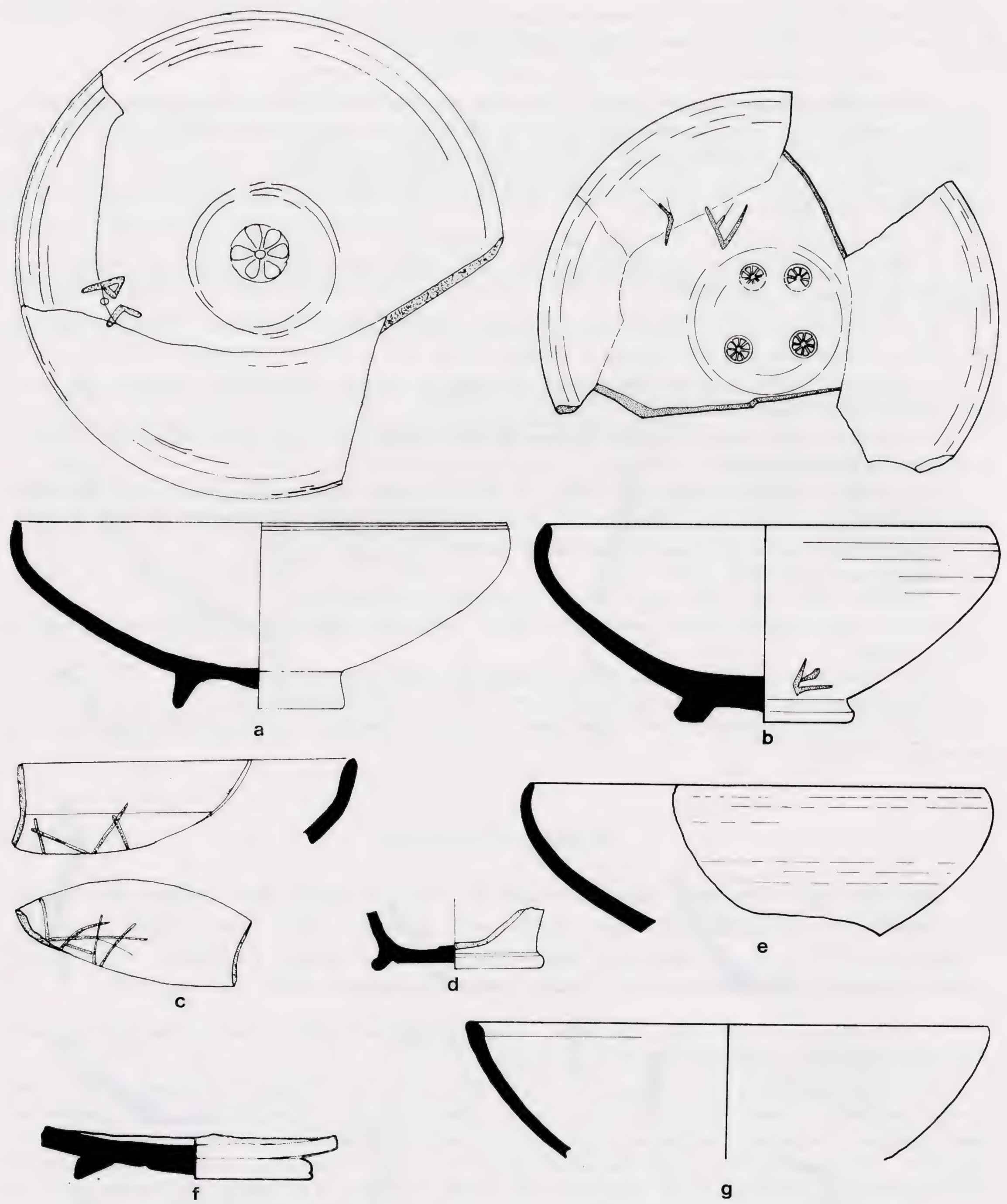


Fig. 103. – *a*) SI/24/71; *b*) SI/11/72; *c*) SI/293/74; *d*) SI/29/74; *e*) SI/24/72; *f*) SI/72/73; *g*) SI/130/74 (1 : 2).

Graffiti are common on Campanian vases and appear to indicate the users' names, and a companion to 11/72 with a very similar graffito on the outer base has been found at Palermo (M. BONANNO, *Punici e greci sul Monte Pellegrino*, in *Sicilia Archeologica*, 21–22, April-Aug. 1973, p. 58 fig. 4A). Others from Segesta have graffiti in Elymian (M. GAUCI, *Gli Elimi*, in *Sicilia Archeologica*, 23 Dec. 1973, p. 13).

N 21, 72/73 (fig. 103*f*). Foot of a plate in pinkish brown ware, very much worn. All traces of glaze have disappeared.

P. 20* 29/74 (fig. 103*d*) (landward end Starboard ballast). The clay is a well purified mid brown with uniformly thick black glaze, shiny but without metallic sheen. There is a reserved circle free from black glaze underneath the foot. This ware appears to be Attic rather than Campanian, and appears to belong to an Attic 4th century cup.

According to Lamboglia's scheme, bowls like figs. 103*a*; 103*b* are placed in the 3rd century B.C., though bowls of comparable form at Cosa are assigned to the 1st half of the 2nd century (D. M. TAYLOR, *Cosa, Black Glaze Pottery*, in *MAAR* 25, 1967, pp. 65–193, types A21, A22, pp. 148–9). J.-P. Morel has given historical reasons for placing their beginning before 241 at Falerii and before 256 at Kerkouane (*Etudes de céramique campanienne I: L'atelier des petites estampilles*, in *MEFR* 81, 1969, pp. 104–105) and claims even higher dates on grounds of historical events about which there is some doubt; but lower dates have not been established. It is worth remarking that bowls with stamps of four rosettes and single central rosette were popular in Rome itself (*e.g.* P. A. GIANFROTTA et AL., *Scavo nell'area del Teatro Argentina* 1968–69, in *BCom* LXXXI, 1972, fig. 9). Some vessels of Campanian A ware, one of them comparable to 11/72 were also found on the Chrétienne C wreck (JONCHERAY, *op. cit.*, fig. 36).

The problem of origin and significance of fabric colour are complicated by the fact that ' imitation ' Campanian A wares are now known to have been made in Tunisia (M. H. FANTAR, *La tombe de Rabta*, in *Latomus* 31, 1972, pp. 349–67) where the black-glazed bowls produced by a single workshop at Rabta were in variously coloured clays (F. CHALBI, *Céramique à vernis noir de la Rabta*, in *Latomus* 31, 1972, pp. 367–78). There is as yet no clear indication of how long such peripheral workshops may have lasted after the cessation of production in central Italy.

(*For comparable Black Glaze ware found in the wreck-filled zone and near the Punic Wreck, see Appendix II, p. 295,* [*H. F.*]).

THIN BLACK GLAZE

P. 14 *83/71 (*IJNA* 3, no 42) (fig. 104*a*). Rim fragment of a plain bowl, slightly thickened at the top with a maximum thinness of 2 mm. Compact purified medium grey clay with a shiny black glaze. Slight irregular grooves underneath rim on outside.

O. 16* 115/71 (fig. 104*b*) (*IJNA* 3, no. 43). Rim fragment of a bowl with slightly everted club rim 1.6 mm thick. Shiny black glaze wheel faceted.

P 15* 576/72 (fig. 104*c*). Fragment of a bowl rim, edge turned over with groove beneath. The outer surface has horizontal facets. Light pinkish brown clear ware.

Small body sherds O. 17* 131/72 and O. 23* 311/73 are dark grey with black glaze.

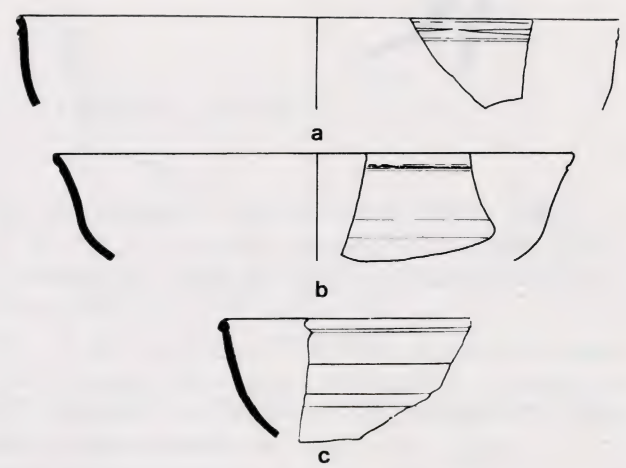


Fig. 104. – *a*) SI/83/71; *b*) SI/115/71; *c*) SI/576/72 (1 : 2).

The closest parallel to 83/71 is to be found in a fine glack blaze dish from Sutri (G. C. DUNCAN, *Roman Pottery from the Vicinity of Sutri*, in

PBSR XX, 1965, form 9, p. 145), a bowl with the same irregular grooves below the rim. *Ibid.* form 5, 10 p. 154 is also a parallel to 576/72 though the ware here is thicker.

There is a little thin black glaze from 2nd century B.C. Veii which appears also connected (M. Torelli and I. Pohl, in *NSc* XXVII, 1974, nos. V236, V238).

Two dishes from beneath the Templi Gemelli pavement which belongs to the early 2nd century appear to be of the type (L. Mercando, in *BCom* LXXIX, 1966, pl. 3 nos. 8, 9).

Red-Glazed Ware Dishes

R. 14* 331/74 (fig. 105 *a*). Several fragments of a refined red-ware red-glazed dish with raised ring base.

R. 23 *507/74 (fig. 105 *b*). Part of a large flat dish in well purified soft ware stained grey. This sherd is much worn and no trace of glaze survives, but both fabric and shape associate it with the piece above.

R. 27 *166/74 (fig. 105 *c*). Part of a wide dish in compact brown ware with slight traces of red slip. There is a shallow external groove below the rim.

O. 11* 484/73 (fig. 105 *d*). Part of the wall of a shallow dish, rim and base missing. The diam. calculation shows that it was large and therefore not much deeper than the surviving wall. The fabric is well purified hard orange covered on both sides with a deep reddish slip. The main feature is the complex series of ribs on the underside which appear to have been made by a comb. It is also ribbed on the inside.

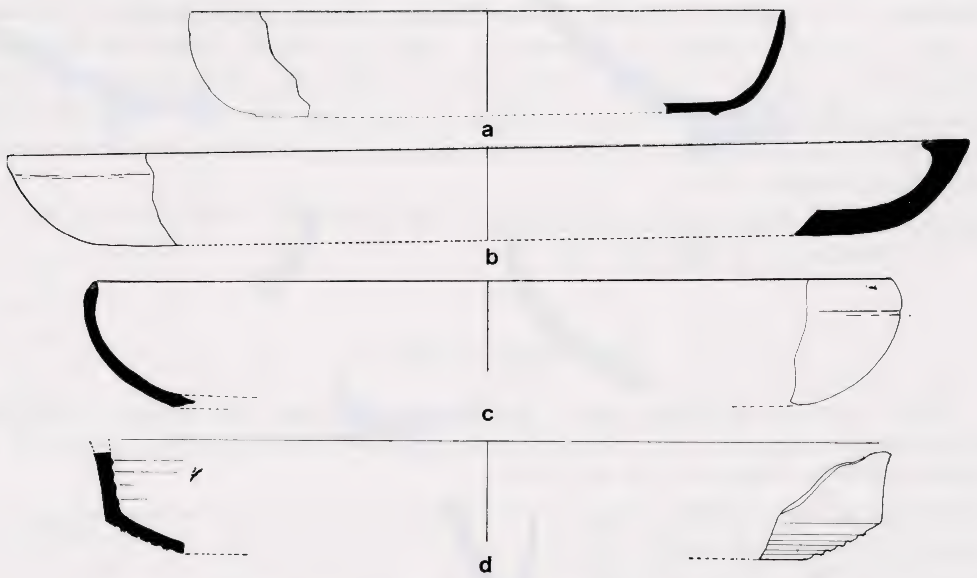


Fig. 105. – *a*) SI/331/74; *b*) SI/507/74; *c*) SI/166/74; *d*) SI/484/73 (1 : 3).

These plates almost certainly originate in Italy where they appear to copy the flat baking dishes of Hellenistic Greece (*e.g.* H. H. Thompson, *Two Centuries of Hellenistic Pottery*, in *Hesperia* 3, 1934, fig. 106). Their date of occurrence in Italy can now be pushed back into the late 3rd century B.C. (C. Goudineau, *Note sur la céramique à engobe interne rouge-pompéien*, in *MEFR*, 82, 1970, p. 159 ff.) although they last well after the end of the Republic. At Ampurias an example occurs in the 2nd century B.C. with Campanian A ware (M. Almagro, *Las necrópolis de Ampurias*, I, 1953, p. 360, fig. 344). They had a long life: both shapes are found in "clear sigillata" pottery of the 2nd century A.D. (N. Lamboglia, *Nouve osservazioni sulla terra sigillata chiara*, in *RStLig* XXIV, 1–2, 1958, form 9; A. Darton, *Sigillé claire de la vallée du Rhône*, in *RStLig* XXXVIII, 2, 1972, p. 155). There appears to be no parallel to the ribbing on the underside of 484/73, but Goudineau (*loc. cit.*, p. 168, pl. 2, 18) illustrates a heavily ribbed lid from Haltern.

Miscellaneous Dishes

Here are illustrated the remaining rim sherds of dishes in various fabrics. With the exception of 162/72 which was from a sealed context, all the other sherds were from the surface of the starboard ballast pile.

30/73 (fig. 106 *a*). Rim fragment in light red clay containing black micaceous and calcareous grits. There is a cream-yellow slip on both surfaces, now partly worn away.

112/72 (*IJNA* 3 no. 39) (fig. 106 *b*). Part of a shallow dish or plate.

Paterae of similar profile are known from stratum VI A at Ventimiglia from the 3rd century (F. Benoit, *Gli Scavi di Albintimilium etc.*, fig. 51, 5).

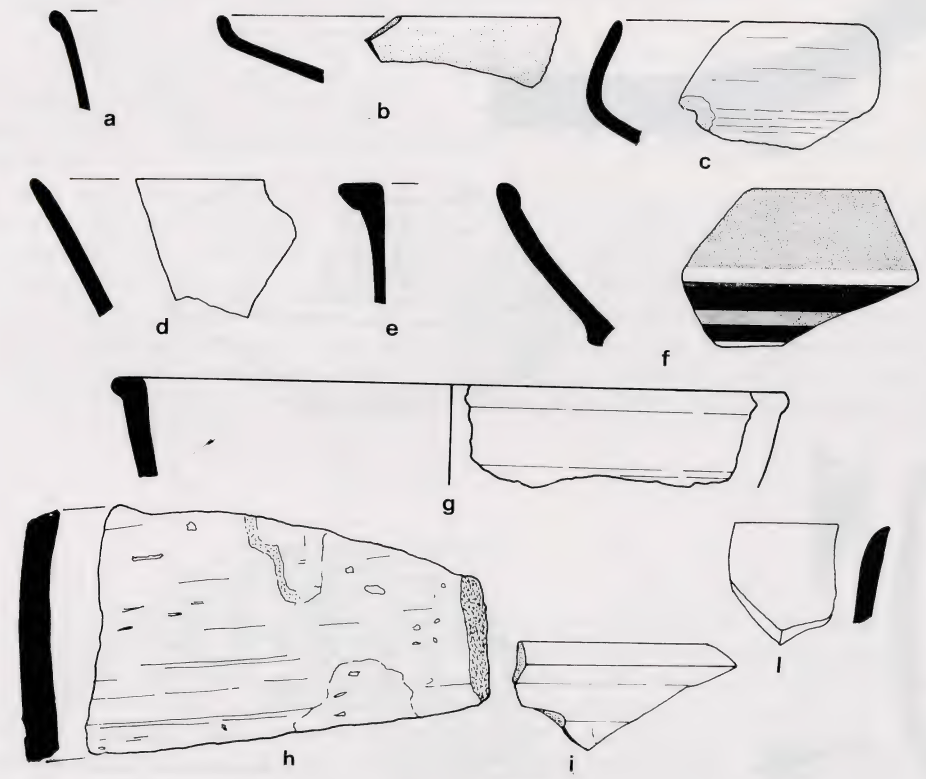


Fig. 106. – *a*) SI/30/73; *b*) SI/112/72; *c*) SI/113/72; *d*) SI/272/73; *e*) SI/47/73; *f*) SI/26/73; *g*) SI/162/72; *h*) SI/111/72; *i*) SI/28/74; *l*) SI/355/74 (1 : 2).

113/72 (*IJNA* 3, no. 38) (fig. 106 *c*). Rim sherd of a shallow-sided bowl in fine well levigated grey fabric.

272/73 (fig. 106 *d*). Plain ware, possibly part of a well-centered plate.

47/73 (fig. 106 *e*). 2 sherds of brownish-grey ware with a reddish core and many small glassy grits.

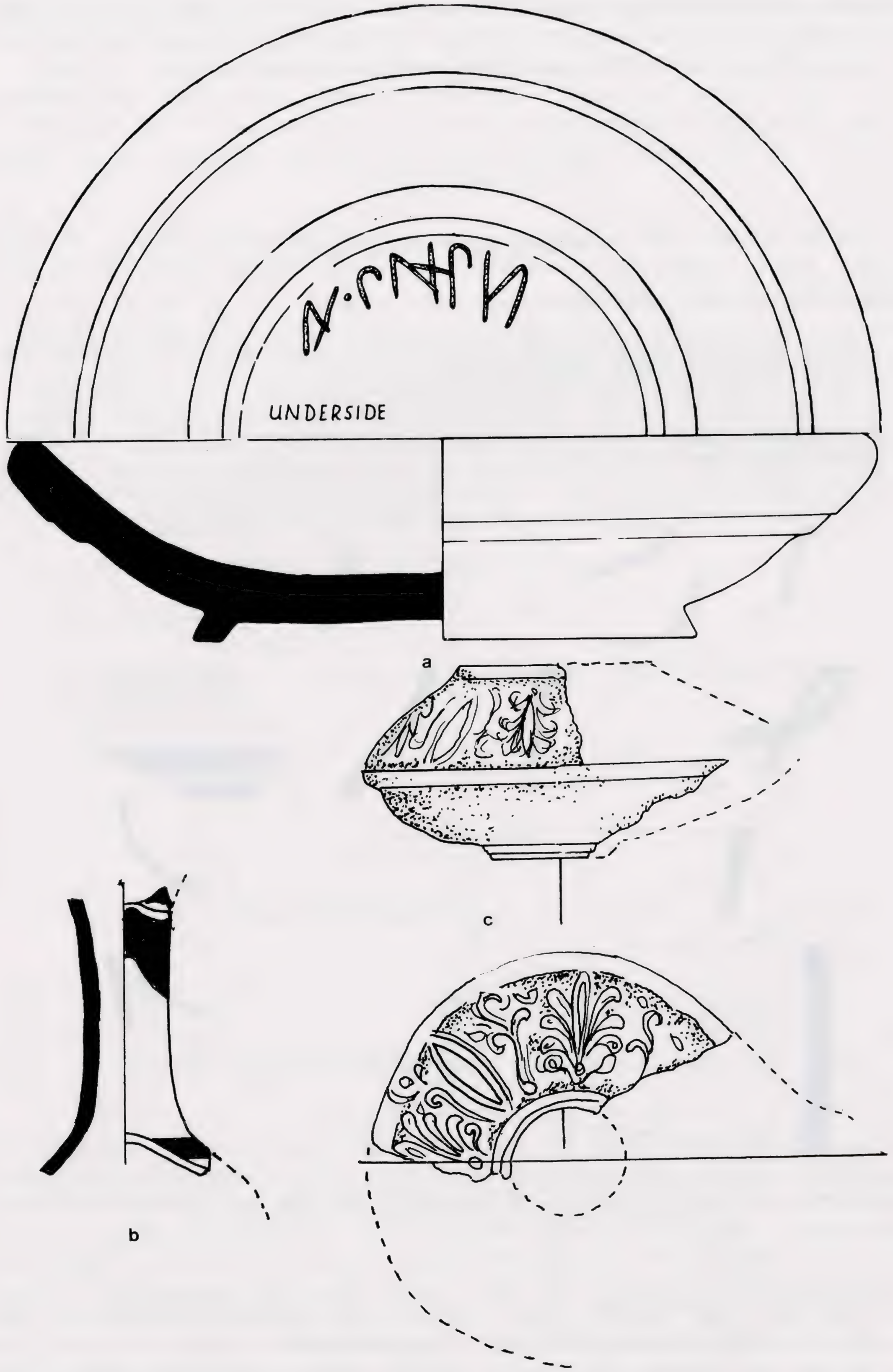


Fig. 107. – *a*) SI/190/74 (1 : 2); *b*) SI/167/74 (1 : 1); *c*) SI/332/74 (1 : 1).

26/72 (fig. 106*f*). (Starboard ballast). Appears to be the wall and foot of a shallow dish. Grey fabric with a light red slip overpainted with lines of dark, purple-red below a band of lighter red. This is the only painted sherd from the wreck.

355/74 (fig. 106*l*). Painted sherd of a dish rim in soft orange well purified ware with a cream slip on both sides.

162/72 (*IJNA* 3, no. 31) (fig. 106*g*). Rim with lip in rather coarse gritty fabric rather like cooking-pot ware, black-grey.

28/74 (fig. 106 *i*). A rim with angular profile in well made dark brown ware stained black in parts. The profile resembles one from Rome (P. A. Gianfrotta et al., *Scavo nell'area del Teatro Argentina 1968–9*, in *BCom* LXXXI, 1972, fig. 4, no. 1422).

112/72 (fig. 106*h*). Water worn sherd of greyish-green ware.

Small Items

T. 26, 167/74 (fig. 107 *b*). (Starboard ballast landward end). Part of neck of an unguentarium in refined tan ware, black paint. It seems to belong to Forti's type Va (L. Forti, *Gli unguentarii del primo periodo ellenistico*, in *Rend. Napoli*, NS XXXVII, 1962) which begins in the last quarter of the 3rd century and lasts most of the 2nd.

R. 14*, 332/7 and 353/74 (figs. 99*c*, 107*c*). Parts of top and base of a moulded lamp of uniform grey ware, very thin fabric, soft and smoothed. The double ridges round the foot and orifice belong to lamps of Hellenistic shape (H. H. Thompson, *Two Centuries of Hellenistic Pottery*, in *Hesperia* 3, 1934, Group E, especially E112 p. 411 ff., fig. 98) and this attribution is further indicated by the palmettes and tresses of the raised design.

Mr D. M. Bailey of the British Museum would prefer to see an East Mediterranean rather than an Italian origin for this lamp, and he suggests a date of the 2nd century B. C. The decoration and form of the lamp may be compared with examples from Kerameikos (J. Schreiber, *Griechische Lampen* (*Karameikos: Ergebnisse der Ausgrabungen* XI) Berlin 1976, no. 515) and Delos (P. Bruneau, *Délos: les lampes*, Paris 1965, nos 2449–2501). The latter are dated between the last quarter of the 2nd century and the first quarter of the 1st century B. C. Further, our specimen appears to be related to one found in a late Hellenistic tomb at Paphos, Cyprus, dating from the 1st century B. C. (*BCH* XCVII, 1969, p. 485, fig. 103). On the other hand comparison in style may be found among 3rd century lamps at Athens (R. H. Howland, *The Athenian Agora*, vol. IV no. 605, pl. 47 and 586 pl. 47).

Mortar

F. 33 *190/74. Mortar from "Kitchen Area II" (figs. 99*d–e*, 107*a*). The ware appears to be greyish under a thick grey coat which has occasional pebbly inclusions. There is an inscription on the underside of the base made after firing which has been interpreted by Miss J. Reynolds as *N. PN. PVI.* She suggests Numerius for the praenomen, which is common in the Oscan-speaking part of Italy, notably in Campania. Miss Reynolds suggests that the diagonal stroke through the second upright of the second N should be another abbreviation mark giving a nomen *Pn* (—), which it is not possible to parallel. PVI, as cognomen, is also without parallel, according to Miss Reynolds, who further suggests a date in the middle of the 2nd century for the P forms, which are comparatively close to the original.

A large variety of mortar shapes were used in the Late Republic and Early Empire (M. Vegas, *Cerámica commún Roman de Mediterráneo Occidental*, Barcelona 1973, fig. 8). The closest parallel to 190/74 comes from Veii (M. Torelli, *A Semi-subterranean Building in the Casale Pian Roseto...*, in *PBSR*, XXV, 1970, p. 79, fig. D) which is 4th century B. C. at latest, so that both type and graffito clearly point to an Italian origin.

Fig. 108. - Tiles from the wreck.

Tiles

The parts of two or three large flat tiles (figs. 108, 109) from " Kitchen Area II " (4/74; 49/74; 50/74; 53/74 making up three tiles) are normal Italian rain tiles, discussed by O. Wikander (O. WIKANDER, *Etruscan Roofing Tiles from Acquarossa*, in *OR* 8, 1956, p. 17 ff.). The Casale Pian Roseto site also has them (*PBSR* XXV, 1970, p. 86 fig. 36). Their characteristic is the raised border on the two long sides, a border which stops about 5 cm short of one of the short sides. The fabric is now grey with a tempering of very large pebbly grits including a very wide scatter of white pebbles. Some of the dark grey core has a slightly reddish tinge. The coating is thick and smooth, also tinged red in places.

Fig. 109. - Tiles from the wreck.

Later examples (3rd century B. C.) come from the Quirinal (A. M. COLINI, *Pozzi e Cisterne*, in *BCom* LXIX, 1941, fig. 6, p. 93) where they occur together with tiles of semicircular section (*ibid.*, p. 95, fig. 7) like wreck examples described below. Others occur at Ardea (A. ANDRÉN, *Scavo sull'Acropoli di Ardea*, in *OR* I, 1954, p. 8, fig. 14).

The other tile type represented is the half cylindrical ridge tiles, which widen or splay slightly towards one end: 266/73; 650/74 and 651/74 are parts of these tiles in a soft buff ware with pebbly inclusions of bricky material. 286/73 and 652/74 are complete examples in a coarse grey ware with large white pebbly inclusions. 653/74 is a ridge tile of this type with a low flange protruding at one end (WIKANDER, *loc. cit.*, p. 19).

Whilst the cylindrical and low-flanged tiles are also Italian types it must be pointed out that all three tiles listed so far were in use in Palermo in the 5th-4th centuries B. C., as is shown by their occurrence in a tomb there containing a lot of 4th century pottery. The contents are in Palermo Museum (P. MARCONI, *Rinvenimenti nelle zone archeologiche di Panormo e Lilibeo*, in *NSc* V, 2, 1941 p. 265, fig. 5).

CONCLUSION

On the whole, the connection of the ship's pottery seems to be with central Italy. Of course some of the amphoras are Punic, but the association of the smaller vessels seems to be overwhelmingly with Italy. Exceptions might be those sherds with inscriptions as a case can perhaps be made out for some of the signs being Phoenicio-Punic, but even here the evidence is equivocal. The tiles seem to be Italian.

The date range of the pots is difficult to establish, since they belong to a period in which neither Italian nor Punic pottery is very closely dated. Though there is much which could be ascribed to the 3rd century B. C., the safest outside limits appear to be 200 B. C. to about 120 B. C., or perhaps earlier if the pieces of Dressel 1 B amphoras do indeed come from the wreck known as " Edgerton ". It is impossible on present comparisons to date the entire assemblage to the late 3rd century. Campanian B is absent, but in any case Campanian A lasted according to most authorities well into the 2nd century B. C. In the circumstances a concensus dating of the late third to the 1st half of the 2nd century B. C. seems most probable.

WILLIAM CULICAN
JOHN E. CURTIS

Notes on the Graffiti on the Pottery

The pottery section and that on the Phoenicio-punic signs painted onto the hull were, of course, written by different scholars who had no opportunity of communicating with each other. The excavation having just finished, I sent copies of the graffiti on the pottery to William Johnstone to complete his information about the other examples of writing found on the wreck. As his conclusions in part differ from those in the preceeding section, I have thought it worth while to print them here.

HONOR FROST

Black glaze bowl: *S1/11/72*, *figs. 95c, 103b.*

A *šin* on the exterior of the side of the bowl just above the base.

Another *šin* on the interior of the side of the bowl; to its left another sign (*bet*?) probably incomplete, as the scatches around it on the glaze show.

Both *šins* are three-pronged, of the angular variety. The left side is vertical; the central line is parallel to the right side.

The three-pronged *šin* replaced the ' saw-toothed ' in the sixth century (J. B. PECKHAM, *The Development of the Late Phoenician Scripts* [Harvard U. P., 1968], p. 170); whereas in the region of Sidon, in Cyprus and in the Punic script the rectangular form predominated, " at Byblos and Arvad... the angular form is retained throughout " (*ibid.*, p. 172), *i.e.*, as late as the third and second centuries. Examples are also known from this late period from southern Palestine and western Cyprus (*ibid.*, pp. 171 n. 91, and 38). Cf., *ibid.*, Pls. I. 1, 5 (Cyprus, second half fifth century); IV. 2-6 (Byblos, fifth to second centuries); V. 4 (Sidon, second half fifth century).

I am less confident of the three that follow.

Lid S1/55/74, figs. 99 b, 101 b

Inscribed with sign which could be *šin* of the Phoenician alphabet (cf. 11/72).

The central line dropping nearly vertically into the juncture of the two sides in the three-pronged angular variety of *šin* " is an early sixth century feature and otherwise rare " (PECKHAM, *op. cit.*, p. 170). Cf., *ibid.*, Pls. I.1 (Cyprus, second half fifth century); IV. 1 (Byblos, first half fifth century); V. 4 (Sidon, second half fifth century); XII.3 (Punic, fifth to fourth century).

Cooking pot S1/150/73, fig. 97 h

Only part of one (?) letter (*ṣade*?) has been preserved on the exterior of the side of the vessel near the rim.

The *ṣade* (assuming the identification to be correct) with short shaft, and fairly large Z-shaped head tilted to the left, " in a predominantly formal and conservative script... undergoes little development between the eighth and the second century " (PECKHAM, *op. cit.*, p. 168).

Amphora handle S1/193/73, fig. 86 p

Conceivably *nun* and *taw* of the cursive tradition evidenced from the fifth century until *ca.* 300 B.C. (PECKHAM, *op. cit.*, Pls. X and XI). The letters could, however, be read as Punic *pe* and *mem* (*ibid.*, Pl. XVI, dated second century B.C.) or as Neo-Punic *nun* and *mem* (*ibid.*, Pl. XVII).

The graffiti on the black glaze bowl 293/74, Fig. 103 *c*, is undecipherable. The incised cross on amphora 46/74, fig. 72 *a*, is ambiguous; if it was Phoenician it would have to be a *taw*, dated perhaps as early as the eighth century (see PECKHAM, *op. cit.*, pl. VII.1). The incised triangular sign on amphora 47/74 (*Appendix* II, Plate 2) and the paint marks on amphora 338/74, fig. 82 *a*, do not appear to be Phoenician.

WILLIAM JOHNSTONE

XII. SIGNS

During the course of the excavation of the ship, it became apparent that the shipwrights had used a considerable number of signs—mostly painted but including some incised—on the timbers to assist them in the work of construction.

No conspectus of these marks was possible while the wood was under water: there were signs on both sides of some timbers, *e.g.*, the keel; even in the case of those on the same side of a timber, as soon as the sand was cleared from one group it would settle on another thus frustrating any attempt to understand the interrelationship of the signs.

It was, therefore, only by the end of the third season in 1973, when the timbers and planks had been raised—independently or in sections—and placed in fresh-water tanks, that the marks could be systematically studied. At that stage self-size tracings were made of the marks, usually several to each tracing, their positions being marked with regard to near-by dowels or nails. When these drawings had been reduced photographically to a scale of 1:5 they were then in turn traced on 1:5 scale drawings of the timbers of the ship. Figures 114–129 thus represent collages of more than fifty originally independent tracings. It was then that, for the first time, the location and interconnection of the marks, and their function in relation to the construction of the ship, could be appreciated.

The difficulties in correctly recording these marks, and the consequent uncertainty about their accurate interpretation, must be frankly admitted. Paint marks applied to wood in single strokes cannot at the best of times be expected to be always completely legible; if they have been made by a craftsman simply for his own convenience and in the knowledge that most of them are soon to be concealed from view as the work of construction progresses, they are likely to be crude and rough. In addition, the materials involved in the present case are now in a condition highly unfavourable for decipherment: the wood, waterlogged, brittle and worn in places, has darkened on exposure to light; the paint, dissolving readily in water to the touch, has at the same time faded (cf., *e.g.*, the 1972 underwater photograph of the squiggle (91) on the interior of strakes 2–3 port with the 1973 on-land photograph of the same timber and sign, figs. 110 and 116). A complicating factor is that there are present other agents of staining beside the paint marks—nails, tacks, lead sheeting, and marine life (cf., *e.g.*, the complicated marks at sign (110) on strake 3 starboard at the seating of floor-timber 13 [figs. 111 and 115 *b*] where it is not clear not only which are deliberate and which accidental, but also which are paint and which run from the nail). Equally misleading at times are unevennesses on the surface of the wood; the grain, the adze marks, and minor abrasions can appear in some lights or from certain angles to be parts of a sign (cf., *e.g.*, the ' talismanic sign ', on the interior of strake 2 port at the seating of floor-timber 9, claimed in preliminary publications [1].

(1) Cf. H. FROST, *First season of excavation on the Punic wreck in Sicily, IJNA* 2, (1973), pp. 44 f. It was included in the provisional table of signs published by H. Frost and J. Curtis in the article *La seconde campagne de fouilles de l'épave punique de Sicile, Archeologia*, 61, 1973, p. 27; cf. J. CURTIS, *II campagna sulla nave di Marsala – osservazioni sulla ceramica, Magna Graecia* VIII, No. 3–4, March–April 1973, p. 12.

The sign had only turned up on photographs of the plank concerned; on examination on dry land it was found to be made up of a fortuitous combination of the much smaller—and straightforward—painted sign (106), with adze marks and indentations in the wood, figs. 112 and 115 *a*).

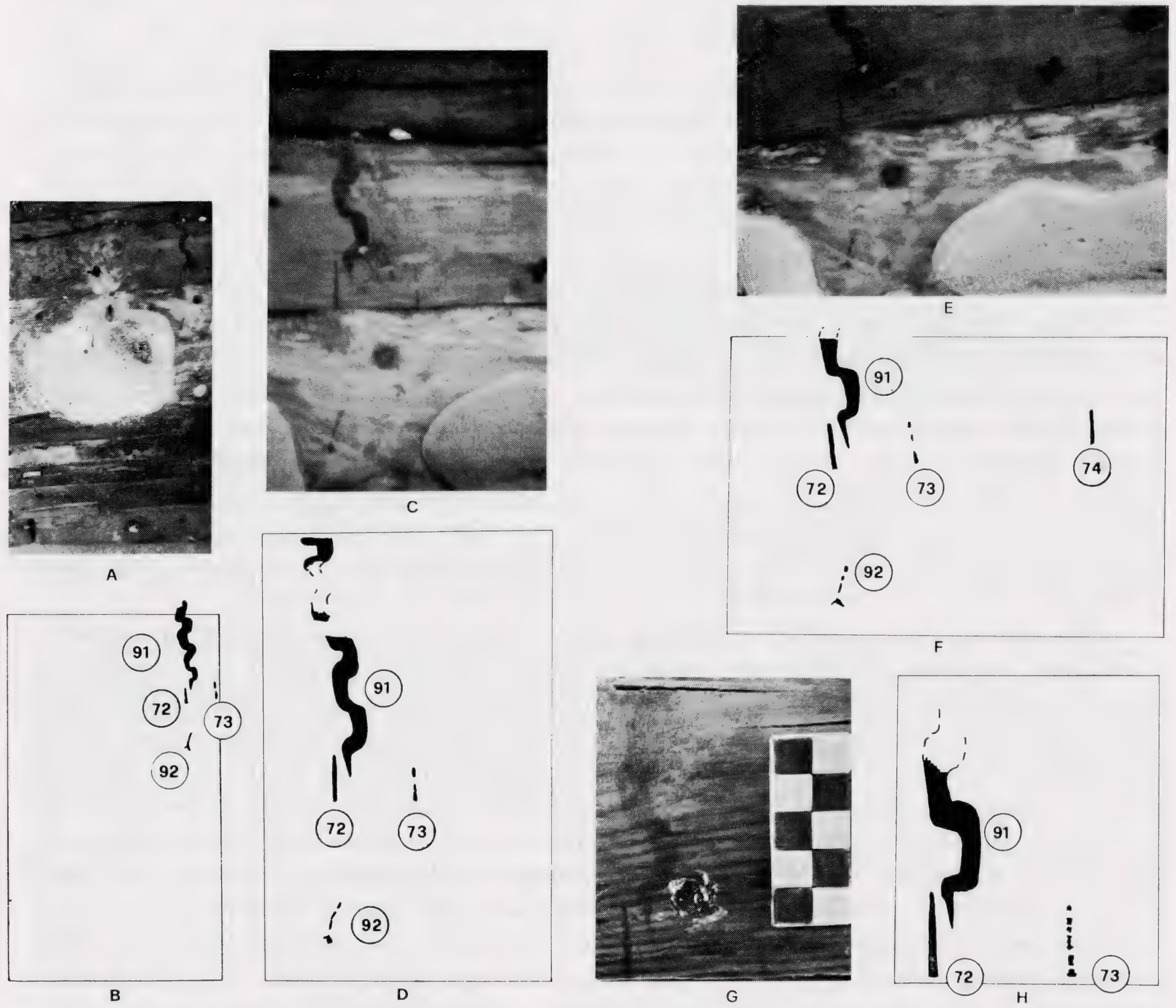


Fig. 110. - The squiggle (91) on the interior of strakes 2–3 port between the seatings of floor-timbers 19 and 21:
A-F as seen underwater in 1972;
G-H as seen on land in 1973.

It had been hoped that an ultra-violet light scanner [2] would aid the accurate discrimination of the painted marks from these others; unfortunately, the paint turned out to have only the weakest fluorescence in contrast to the background wood; despite laborious scrutiny of all the surfaces of all the wood with its aid, the scanner was of no assistance in recovery and/or definition, and, indeed, yielded no paint marks beyond those already visible to the naked eye [3].

(2) The scanner used was the Fluotest Forte (Original Hanau Quarzlampen, G.m.b.H.).

(3) I am grateful to Dr. H. McKerrell, Research Laboratory, National Museum of Antiquities of Scotland, Edinburgh, for valiant, if unavailing, efforts to find a simple chemical means of making the marks more distinct. The attempt was frustrated by the iron level of the wood which rendered an easy accentuation of the marks, themselves made with an iron-based paint, and their ready differentiation from the wash from the nails, impossible.

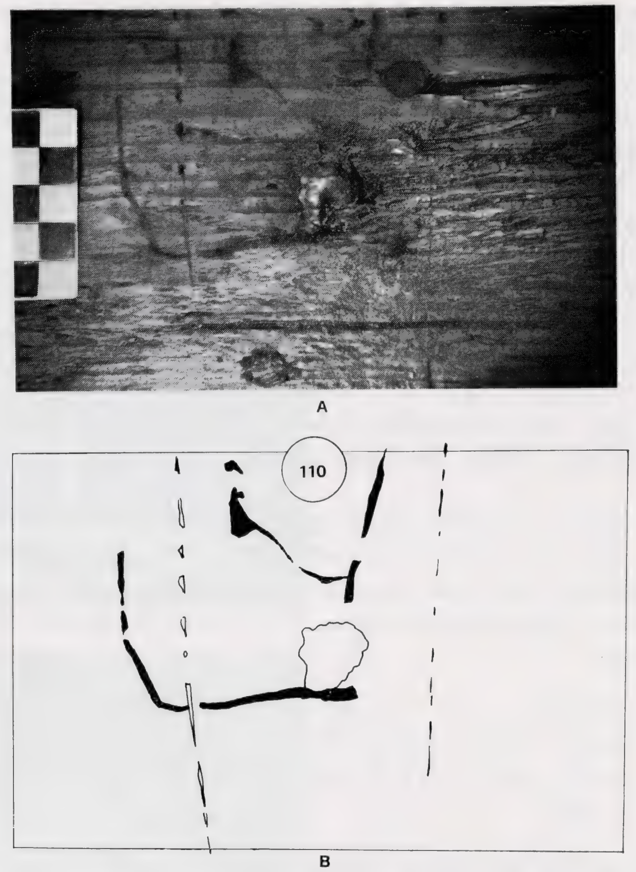


Fig. 111. - Paint marks (110) on the interior of strake 3 starboard at the seating of floor-timber 13 as seen on land in 1973. Note typical scored guide-lines for the location of the floor-timber.

The discussion which follows is divided into three sections. First the repertoire of marks is presented and classified. The second section discusses the relationship of the marks to the process of the construction of the ship; it is in this section that the marks, except some which are judged to be purely accidental, have their numbers assigned to them according to the broad order in which, it is argued, they were applied. Finally, some comparative observations are made.

§ 1. *The repertoire of marks.*

The complete repertoire of marks is recorded on figs. 114–129 [4].

These signs may be classified as follows (in the classification no account is taken of those, mostly unnumbered, regarded as merely accidental, or as accessory to those deliberately applied; those in this category which nonetheless do appear in the numbered series are 44, 92, 93, 95, 98, 102, 108, 115, 116, 119, 130, 131).

(4) Fig. 113 provides the key whereby figs. 114–122 may be severally located on the ship. I am responsible for the original tracings of the signs and for superimposing them on drawings of the timbers and planks of the ship by M. Anderson, P. Ball, P. C. Brachi, H. Frost, and P. Giacalone. I am respon-

§ 1.1. *Simple marks.* A large number of the marks are simple, primitive signs, which are used naturally and spontaneously to mark positions of timbers, dowels, etc. These marks are not derived from any alphabet or other conventional series of symbols (though, no doubt, they could be traditional in shipbuilding). To this group belong the ticks at the edge of mortises or marking the location of dowels on the faces of timbers (1–3, 19–32, 35–39, 42, 46–51, 53, 56, 59, 60, 63, 65–88, 100, 101, 120, 136 ff.; there is also tick (203) across the edge of the "gangway" plank P9), crosses, or, at least, signs assumed to be variations of the cross, mostly indicating the position of nails or mortises (33, 54, 55, 57, 58, 61, 62, 64, 201) (fig. 130), the line drawn down the centre of the keel (34), the incised inverted 'V' at the starboard garboard scarf (45), the squiggle on the interior of strakes 2 and 3 port opposite the upper edge of the scarph on the keel (91), the incised 'X' on the interior of strake 13 port between the seatings of rib 18 and floor-timber 19 (99), the painted guide-lines (52, 89, 90, 122, 127 (?), 129), and the dashes at floor-timber/rib seatings (114, 121, 132, 202). In all, this group amounts to some 100 signs or more.

§ 1.2. *Complex marks.* The remaining signs (about 40) are of a more complex character (see fig. 149 for the more certain of them). They would appear to be conventional symbols, mainly alphabetic; they also appear not merely to mark position but to convey additional information or specific instructions, *e.g.*, about sequence. They are numbered in the series as follows:

4, 5, 6, 7 (?), 8, (9 ?), 10, 11, 12 (13 ?), 14 (?), 15 (?), (16?), 17 (?), 18 (?), 40, 41, 43 (?), 94 (?), 96 (?), 97 (?), 103 (?), 104 (?), 105, 106, (107 ?), (109?), 110 (?), 111, 112 (?), (113?), (117?), 118 (?), 123 (?), 124, 125 (?), 126, 128, 133 (?), 134 (?), 135 (?).

(A number included in brackets above represents a sign whose existence is assumed on analogy, but which either has left only an indeterminate trace or is presumed to be concealed by putty; a number followed by a question-mark in brackets denotes a sign which is regarded as incomplete or of uncertain reading.)

§ 2. *The marks and the construction of the ship.*

§ 2.1. *The progressive use of marks.* Fundamental to the discussion here must be the recognition that the shell of the ship—or rather, as will be argued below (§ 2.10), part of it—was built before the floor-timbers were inserted. This is clear from the fact that guide-lines to locate the floor-timbers have been scored down across the interior of the strakes

sible too for most of the on-land photographs of the signs; the underwater ones were taken by Miss H. Frost. It will be appreciated that under the conditions both underwater and on-land photography was difficult and its results often unsatisfactory; it is therefore unfortunately impossible to give photographic documentation for every mark detected. Even where signs are photographically documented, the quality of the photography often leaves much to be desired. An attempt has therefore been made in a number of cases to compensate by providing more than one photograph. Not all of these photographs include a scale; the scale in these cases can, however, be gauged by comparison with a companion photograph or by relating the photograph to the scale-drawing of the ship in figs. 114–129, where the signs are drawn to scale *in situ*. Alphabetic signs have been photographed as the letters would normally have been read, though in some cases they were actually written upside down on the ship; here again the scale-drawing of the ship records the disposition of the signs as actually found. I am greatly indebted to Miss Frost for technical assistance in the presentation of both drawings and photographs.

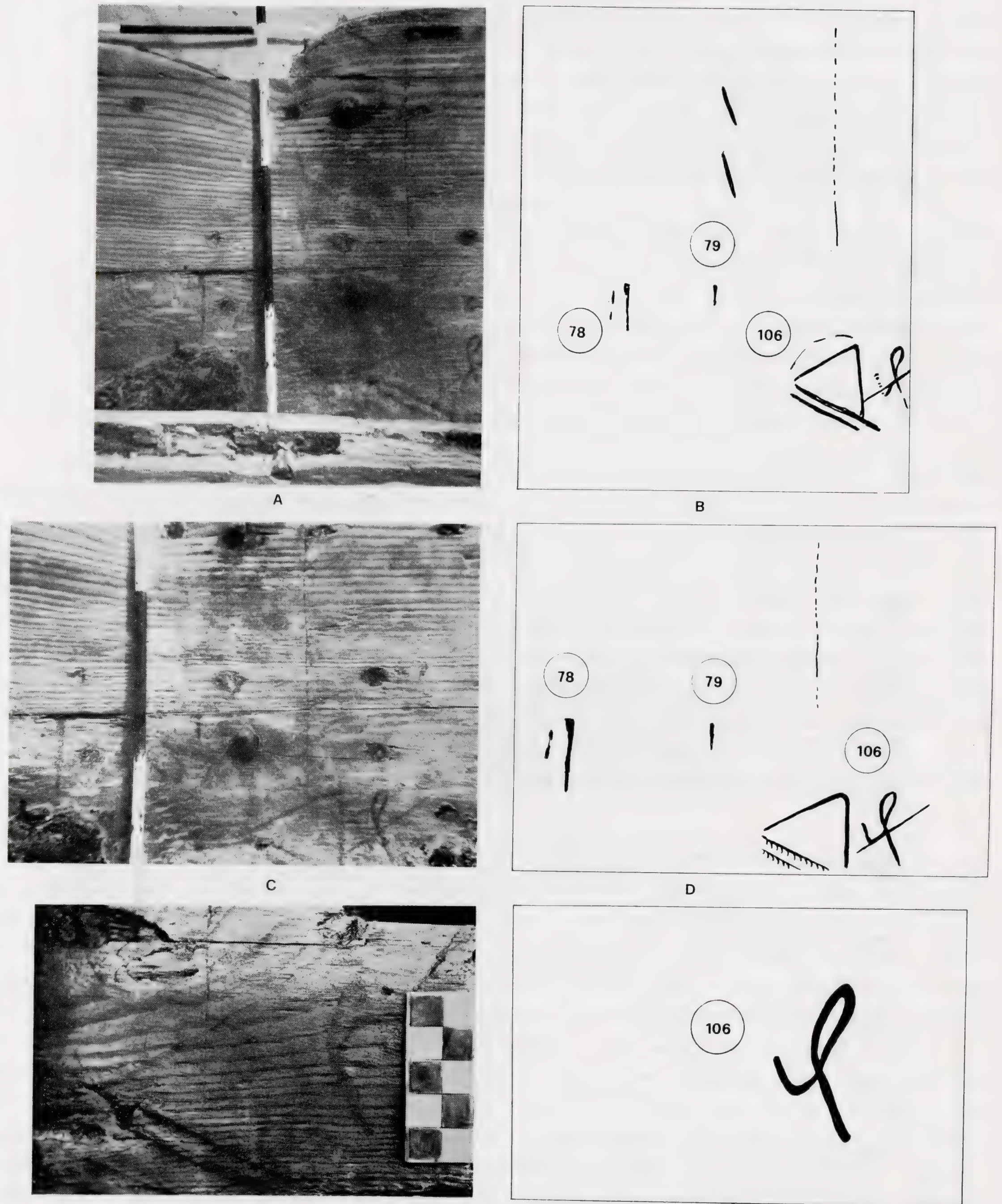


Fig. 112. – Sign (106) on the interior of strake 2 port at the seating of floor-timber 9:
A-D as photographed underwater on discovery in 1971 and as interpreted in previous publications;
E-F as seen on land in 1973.

Note the typical scored guide-lines for the location of the floor-timber.

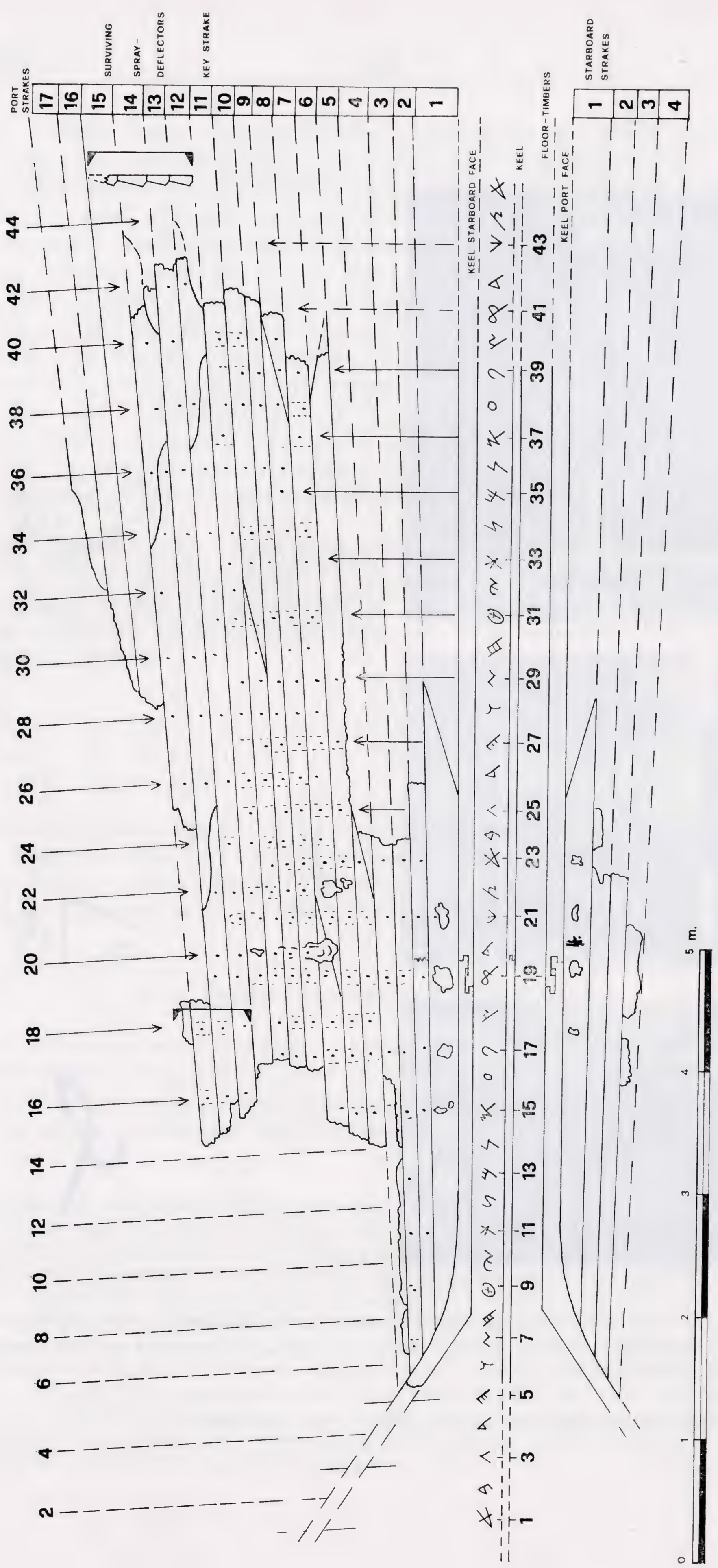


Fig. 113. - Key, showing the three faces of the keel, the numbering of the floor-timbers and ribs and of the port and starboard strakes on the interior of the hull planking of the ship, for the location of figs. 114-122.

of the ship only when these strakes had already been built, and also from the fact that the putty seatings of a number of the floor-timbers and ribs extend over a number of strakes. It is, therefore, already apparent that there must have been a number of phases in the construction of the ship. It will be argued below (§ 2.10) that the procedure was as follows: after the keel had been laid down, the sides up to and including strake 11 were attached by ' shell construction '; the floor-timbers were then inserted; thereafter higher strakes were added as a prefabricated unit again by ' shell construction '; only then were the ribs inserted. The question therefore arises whether the painted marks were applied progressively as the work of construction advanced through its phases.

Perhaps the clearest preliminary indication that the marks were progressively applied is the paint spill (119) on the interior of the starboard garboard between the seatings of floor-timbers 19 and 21 (fig. 116). This spill has run down only to the top of the bevel on the starboard garboard at which it had been shaped to fit onto the starboard rabbet on the top of the keel. The starboard garboard must therefore have already been attached to the keel when this spill occurred. But already marks had been used in the construction of the keel itself and in the preparation to fit the starboard garboard, as will be argued below (§ 2.2 ff.).

§ 2.2. *Paint marks associated with the construction of the keel.* The keel was assembled before the garboard-strakes were attached to it. This is required by the complicated nature of the keel scarf: halved, notched, tongued and grooved, the ends of the two timbers could only be fitted together by being overlapped, then slid together, first vertically and then horizontally, before being locked by means of the central wooden plug. Already at the stage of preparing to fit the two extant parts of the keel together vertical ticks (1) and (2) (figs. 116, 131 and 132) were painted one on each face of the forward of the two timbers at the point where the plug was to be driven through: that on the starboard face (1) is at the after end of the plug (it appears to be further forward but the timber there has cracked and started); that on the port face (2) is at the middle of the plug.

The obscure mark (3) (fig. 114) on the port face of the after timber of the stern may be related to the construction of the stern-post.

§ 2.3. *Forward planning of the position of the floor-timbers.* It is not clear that any other paint mark on the keel is to be associated with the assembling of the keel itself. Either, or both, of signs (11) and (12) (figs. 116, 131, 132), which are located on the sides of the keel at the keel scarf, may belong to the fitting together of the two keel timbers. Since, however, other signs (4-10 and 13-16) on the sides of the keel (figs. 114-118) appear to be in line with the seating of floor-timbers, it is probable that these signs at the keel scarf concern not the scarf itself but the positioning of floor-timber 19 which runs across it above. As will be seen below in the discussion of the fitting of the floor-timbers, there is reason to suppose that sign (12) on the port face of the keel, which looks like the letter *qop* in the Phoenicio-Punic alphabet, concerns the position of floor-timber 19 in the sequence of floor-timbers. The fact that at the seating of floor-timber 19 there is, exceptionally, a sign on both sides of the keel may have something to do with the fact that floor-timber 19 runs across the keel scarf, a point of possible weakness, and is (consequently?) the floor-timber with the highest rise (to strake 13 port) of any of the extant floor-timbers. It thus appears that a certain amount of planning of the positioning and spacing of the floor-timbers was already worked out on the sides of the keel in relation to points of possible weakness in the structure of the whole ship. Yet, since the next stage of the operation involved the building up of the sides,not the fitting of the floor-timbers, a certain number of these signs had to be transcribed to suitable points on the interior of the sides.

§ 2.4. *The cutting of mortises on the keel.* When the keel had been assembled, the next operation was the cutting of the mortises in the rabbets along the top of the keel to receive the tenons attaching the garboards to the keel. That the mortises were cut after the fitting together of the two parts of the keel is made certain not simply by the complicated character of the keel scarf but also by the fact that a mortise on the starboard rabbet on the top of the keel at the keel scarf actually spans both timbers.

There are some paint marks associated with the cutting of these mortises. These are ticks, roughly in line with the edge of mortises, painted vertically to the edge of the rabbets on both sides of the keel—on the port side (19)-(21) (figs. 114 and 115) between the seatings of floor-timbers 7 and 9, (22) and (23) (fig. 115) between the seatings of floor-timbers 11 and 13, (24) (fig. 115) at the seating of floor-timber 15, (25) (figs. 115–116) between the seatings of floortimbers 15 and 17, and (26)-(28) (fig. 116) between the seatings of floor-timbers 17 and 19, and on the starboard side (29) (fig. 116) just forward of the keel scarf, (30) (fig. 117) aft of the seating of floor-timber 25 and (31) (fig. 117) (merely the same tick written twice?) between the seating of floor-timbers 25 and 27. In the last mentioned area, there are also two incised vertical ticks (46) and (47), perhaps for the same purpose, though, more likely, they are satellite marks of the incised inverted ' V ' sign (45) (hence the numbers they have been given in the sequence).

While most of the paint marks on the top of the keel, as will be argued below, concern the location of the nails securing the garboards into the rabbets along the top of the keel, it is possible that tick (32) (fig. 116) at the seating of floor-timber 21 may also have marked the edge of a mortise, if it is not to be associated with the location of floor-timber 21 itself.

The cross (33) (figs. 115 and 130) on the top of the keel between the seatings of floor-timbers 9 and 11 may be conveniently mentioned here. While its port end points to the forward side of a mortise in the port rabbet on the top of the keel, and its starboard end points to the after side of a mortise on the starboard rabbet, its more likely function is to mark the point where the top of the keel leaves the horizontal and begins the curve into the stern-post. It is to be noted that there is a matching cross (54) (figs. 123 and 130) on the exterior of the port garboard, which, unlike the other crosses on the exterior of that same plank, does not point to the location of a nail or dowel.

It may be further noted that, in the case of the keel as on other timbers, ticks associated with the edge of mortises have been used only sporadically; more often, the skill of the craftsman seems to have enabled him to proceed by the judgment of his eye.

§ 2.5. *Marks on the top of the keel associated with the fitting of the garboards.* Though only vestiges of it remain, there was clearly a line (34) (figs. 114–117 and 134) painted down the middle of the top of the keel[5]. It is noticeable that most of the signs to the port side of this central line concern the fitting of the port garboard while those on the starboard side concern the fitting of the starboard garboard. The simple strokes (35)–(39) (figs. 116 and 117) perpendicular to the central line between the seatings of floor-timbers 21 and 25 (is (38) an alternative to (37)?), and at the seating of floor-timber 25, as well as

(5) In 1979, on completion of the reconstruction of the ship in its museum in Marsala, the director commissioned the construction of a replica of the keel. Quite spontaneously the Bonanno brothers, the local shipbuilders entrusted with the commission, drew a line down the centre of the top of the length of wood which they were using for the replica. They explained that the reason for this was to enable the rabbets on the top of the keel to be cut exactly symmetrically. It seems likely, therefore, that the line on the top of the original keel was drawn very early in the process of the construction of the ship and ought more properly to be assigned a lower number in the sequence of the application of the paint marks.

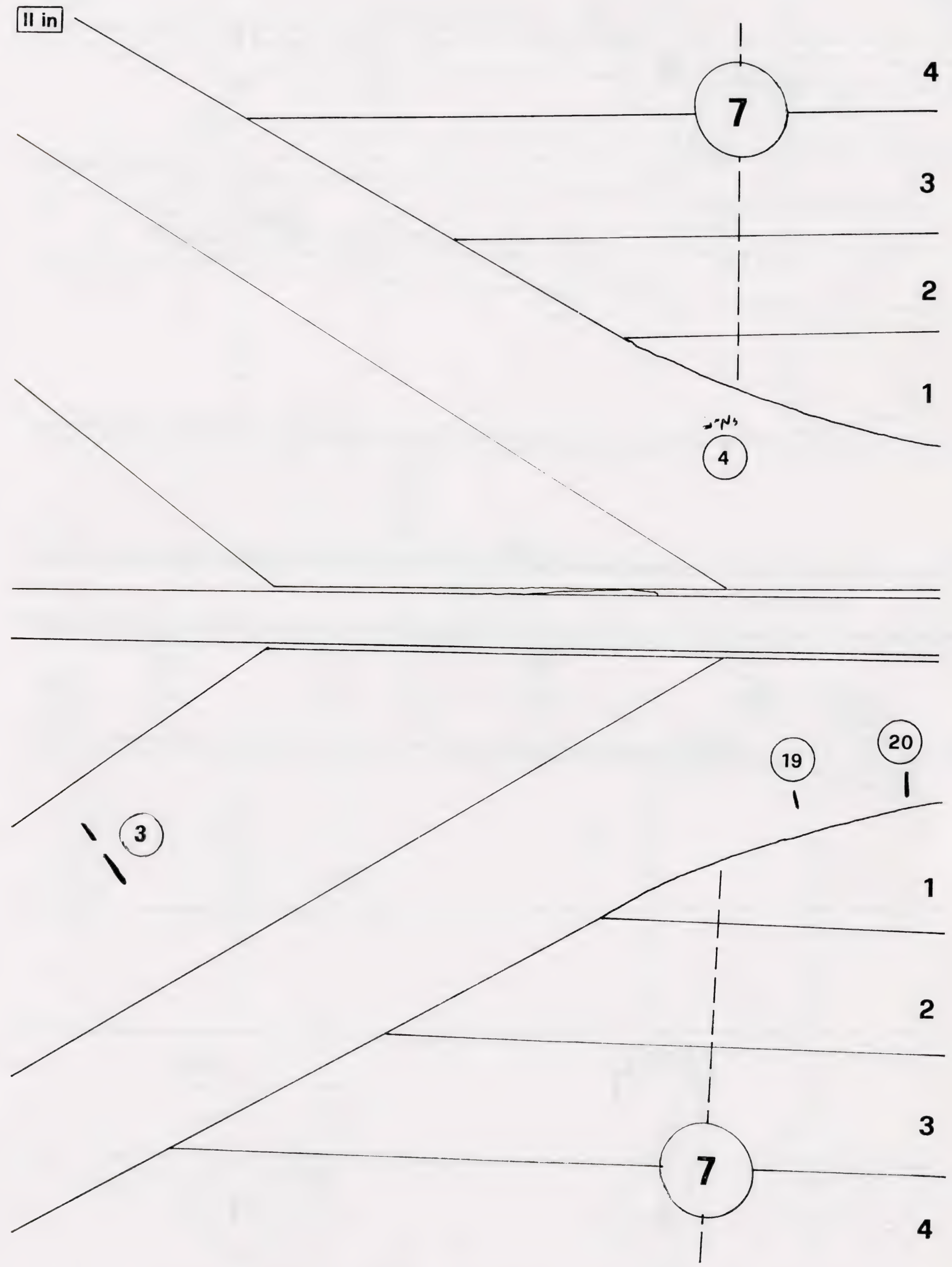


Fig. 114. – The stern; the interior of the ship: floor-timber 7, strakes 1-4 port (above) and starboard.

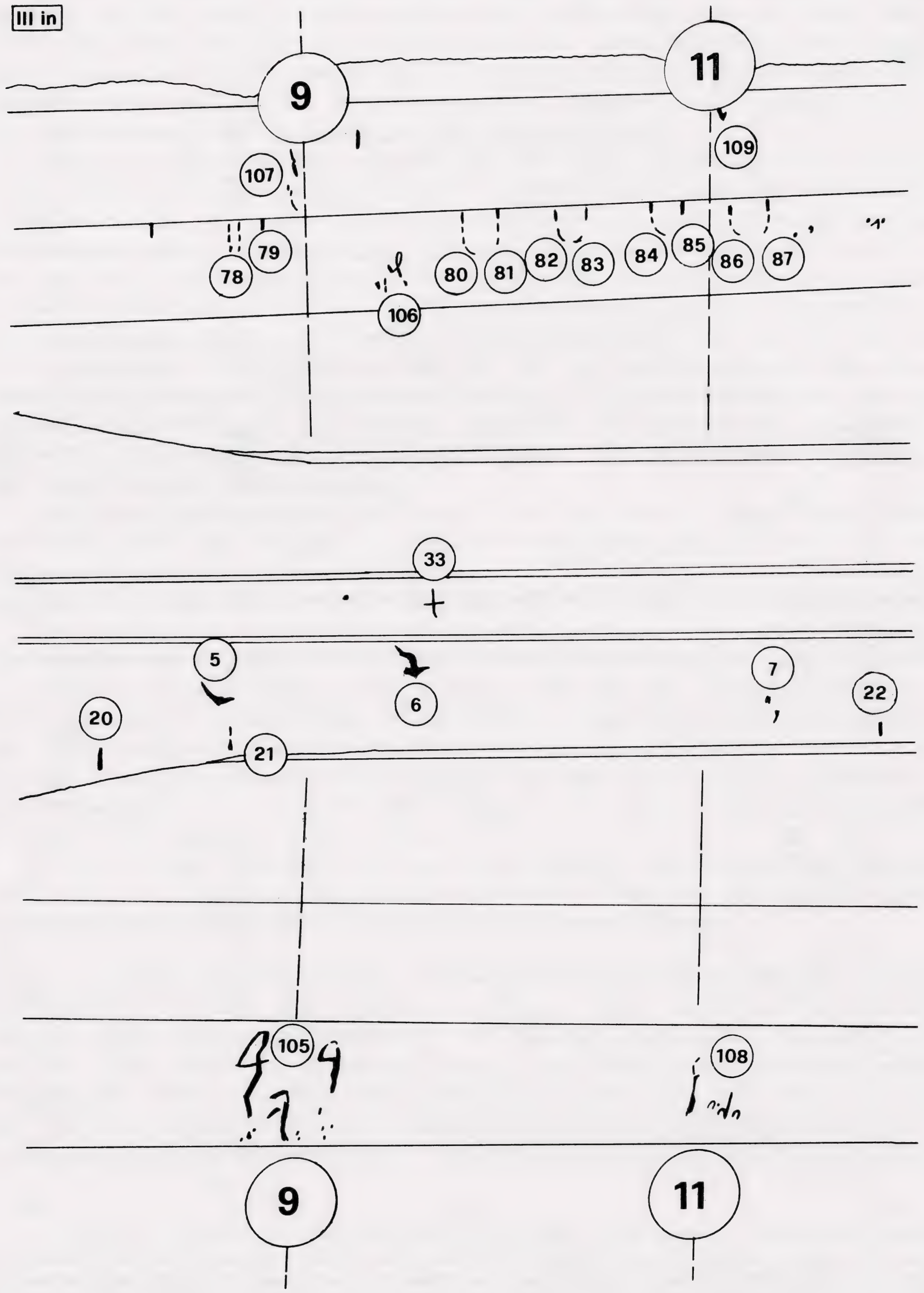


Fig. 115 *a*. – The interior of the ship: floor-timbers 9 and 11, strakes 1–3 port (above) and starboard, with associated signs.

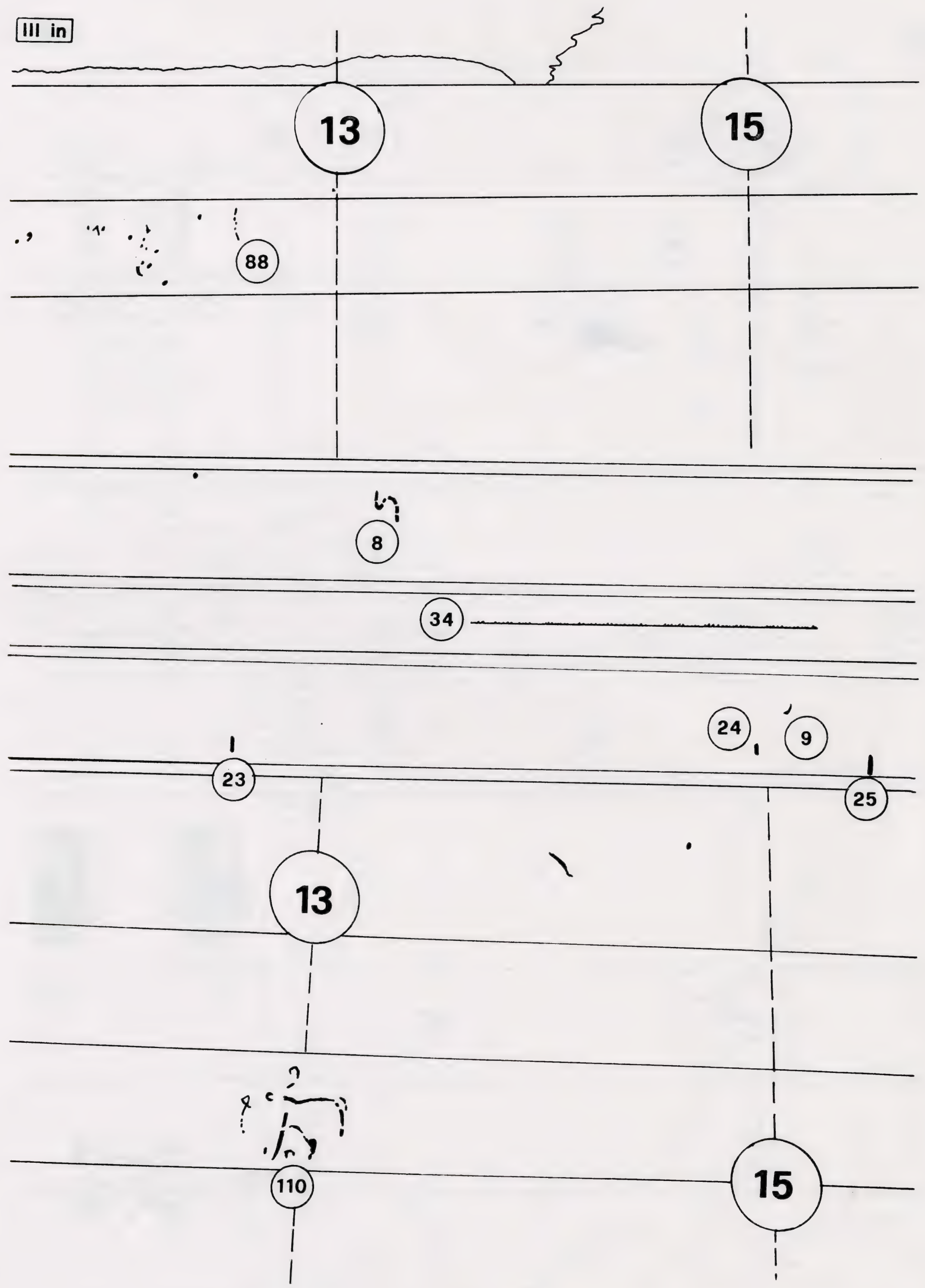


Fig. 115 *b*. – The interior of the ship: floor-timbers 13 and 15, stakes 1–3 port (above) and starboard, with associated signs.

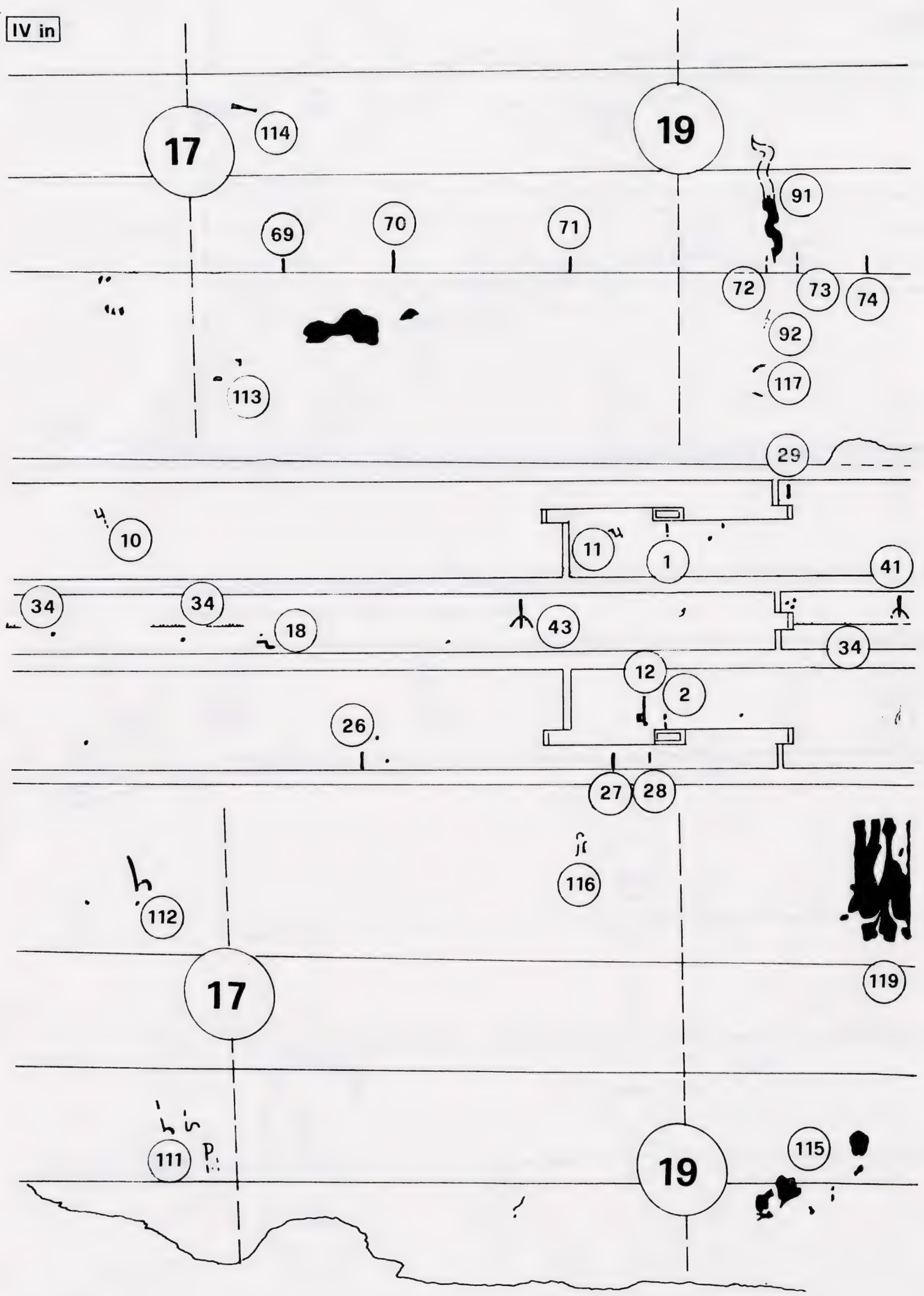


Fig. 116 *a*. - The interior of the ship: floor-timbers 17 and 19, keel scarph, strakes 1-3 port (above) and starboard, with associated signs.

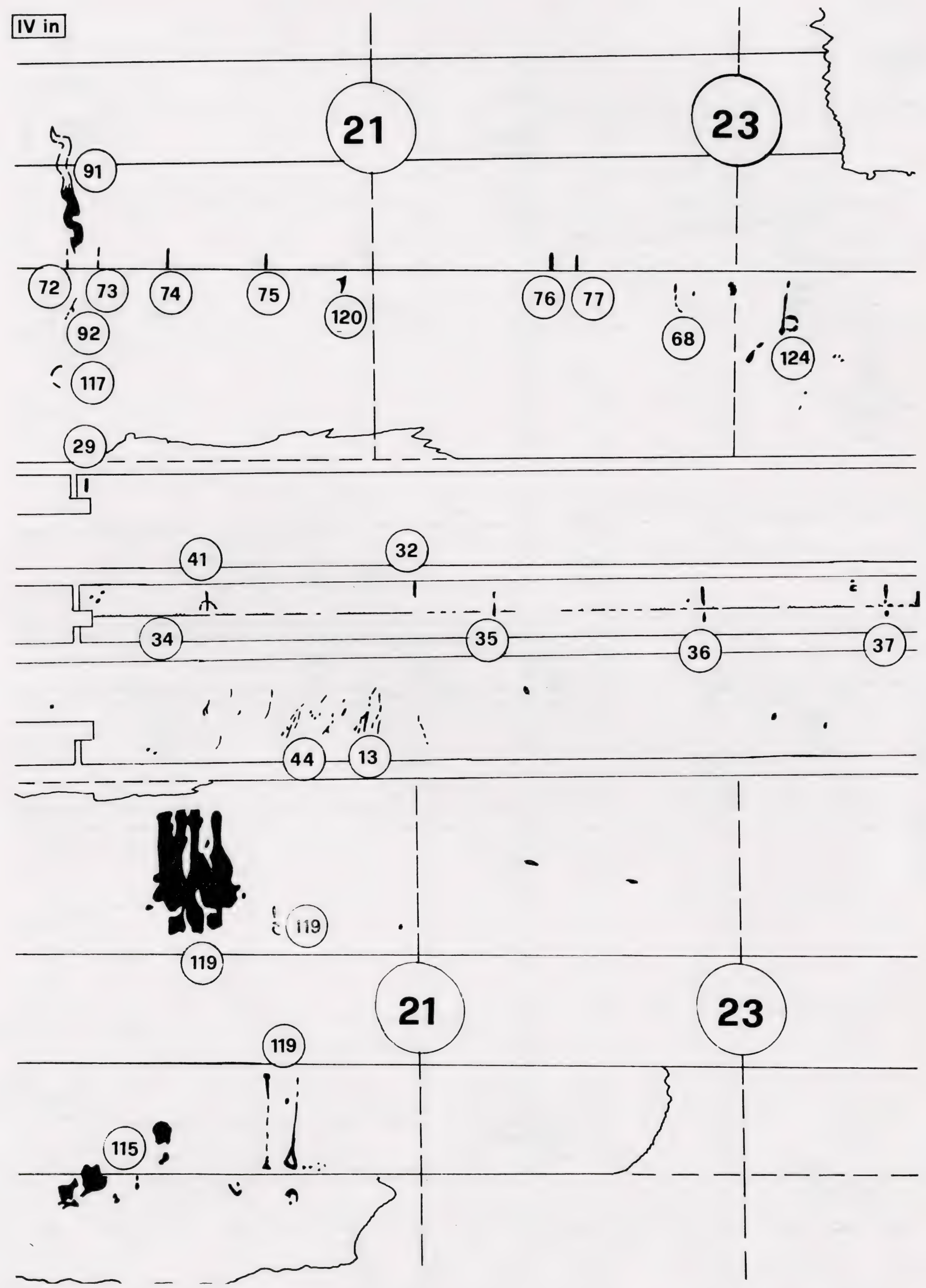


Fig. 116 *b*. - The interior of the ship: floor-timbers 21 and 23, keel scarph, strakes 1-3 port (above) and starboard, with associated signs.

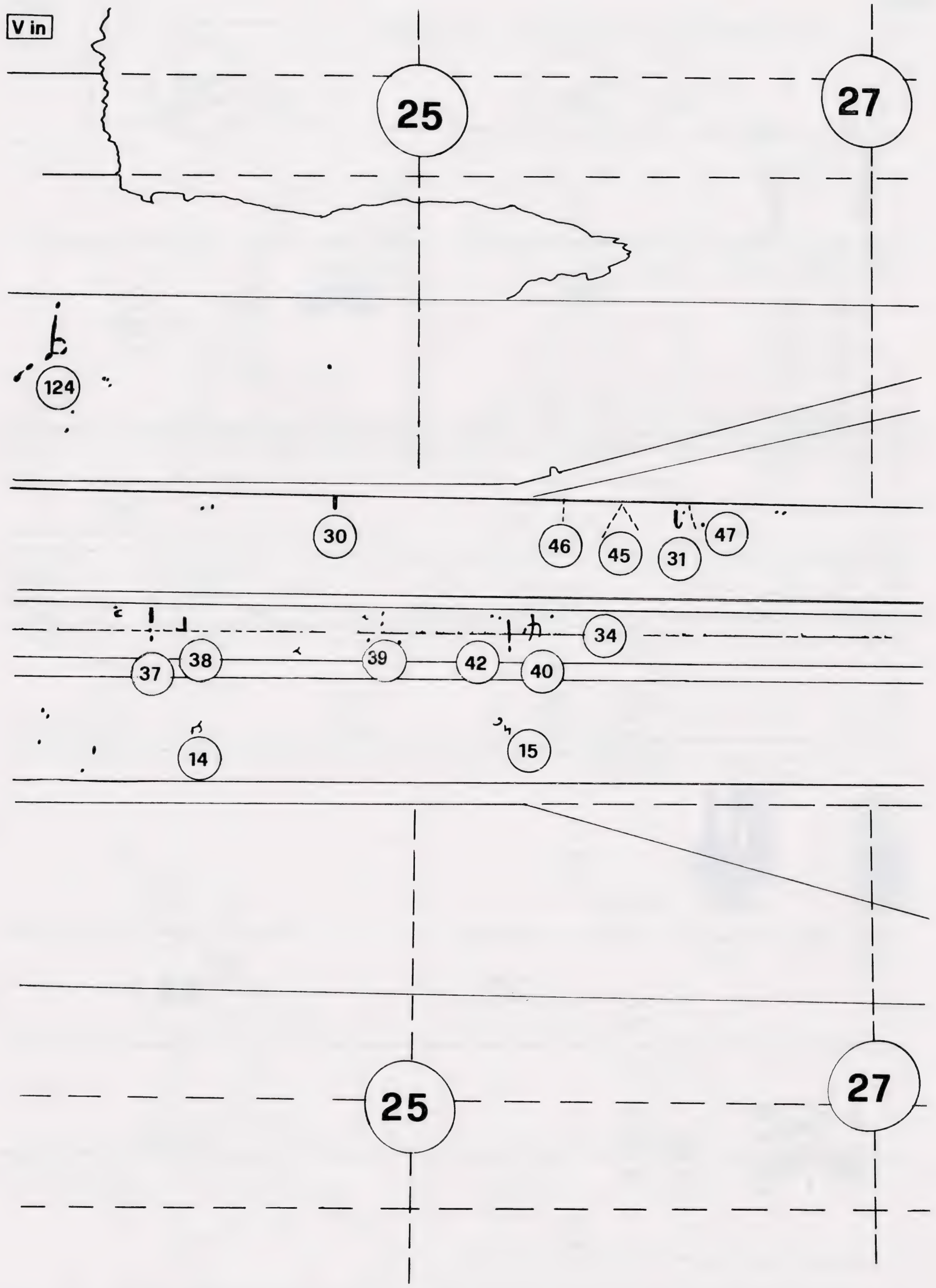


Fig. 117. - The interior of the ship: floor-timbers 25 and 27, garboard scarphs, with associated signs.

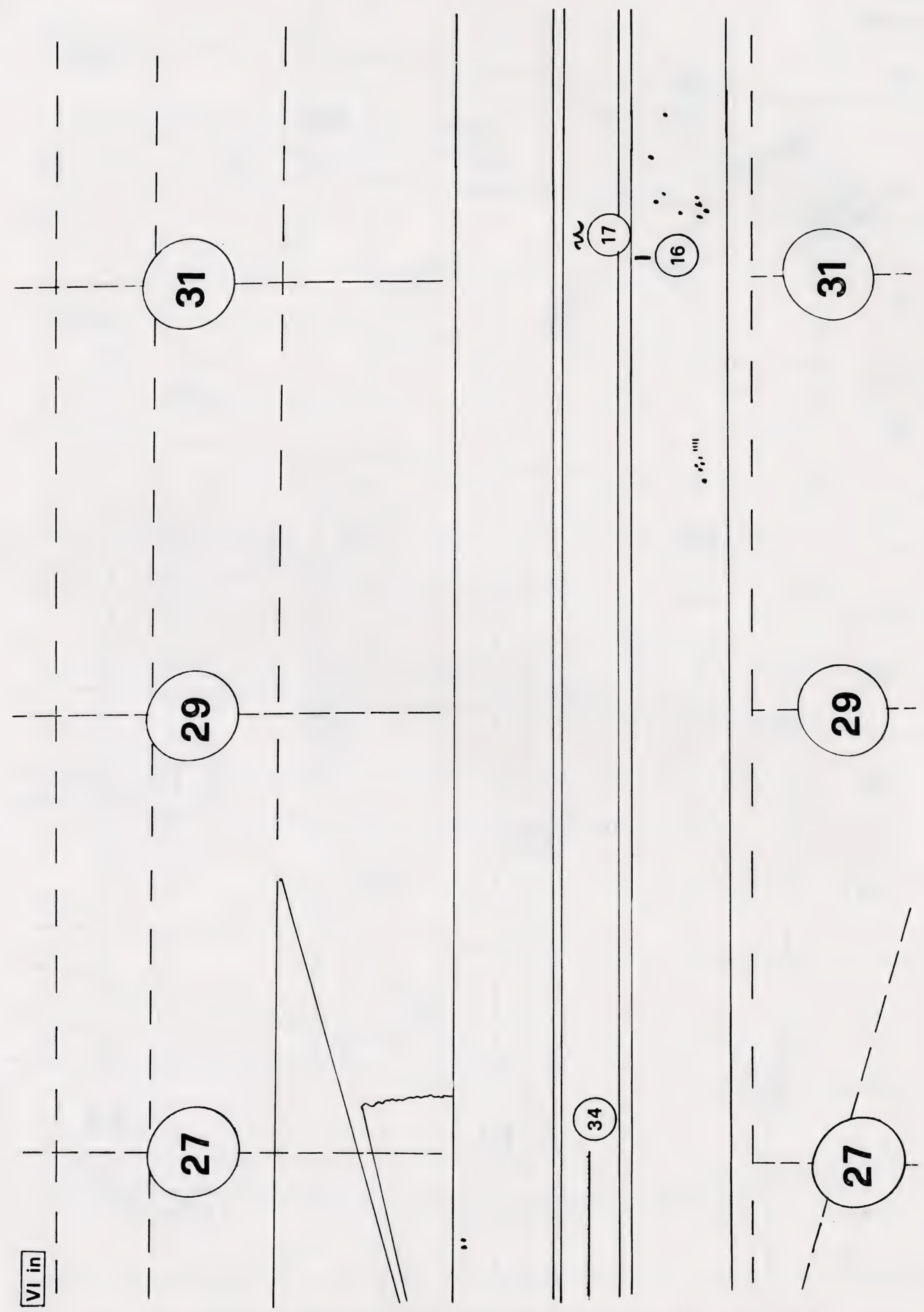


Fig. 118. - The keel at floor-timbers 27-31.

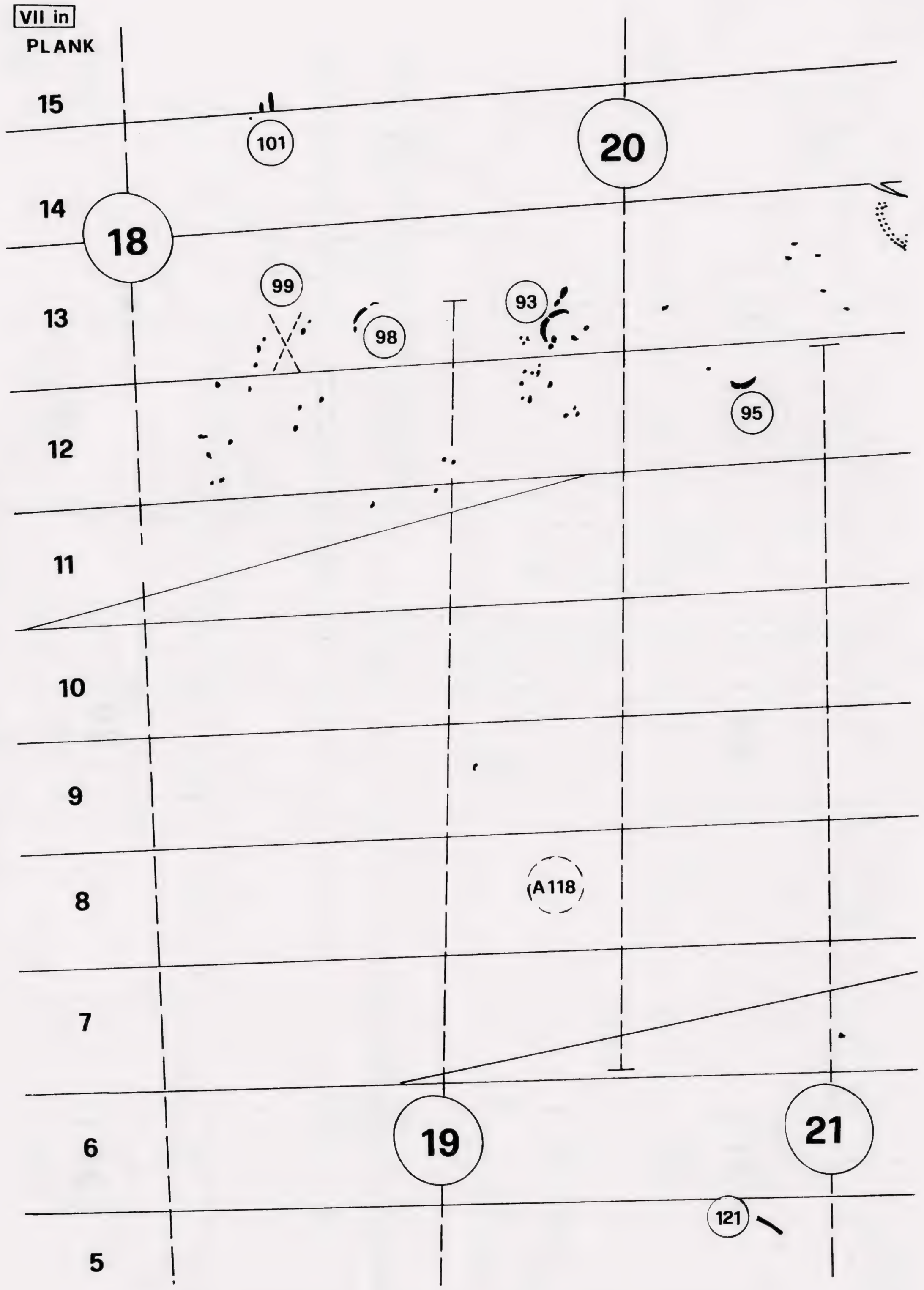


Fig. 119 *a*. – The interior of the ship: ribs 18 and 20, floor-timbers 19 and 21, strakes 5–15 port with associated signs.

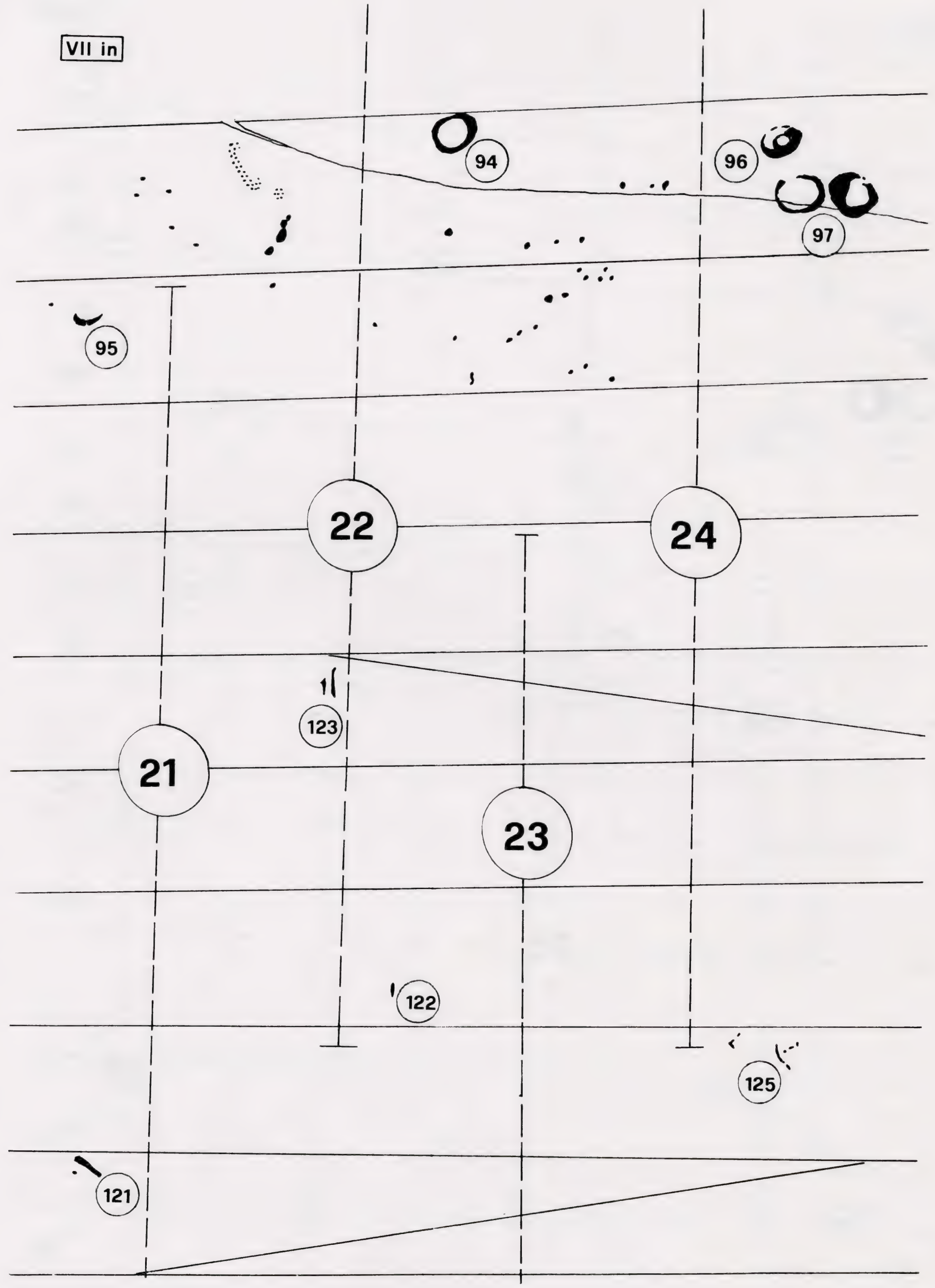


Fig. 119 *b*. – The interior of the ship: floor-timbers 21 and 23, ribs 22 and 24, strakes 5–13 port with associated signs.

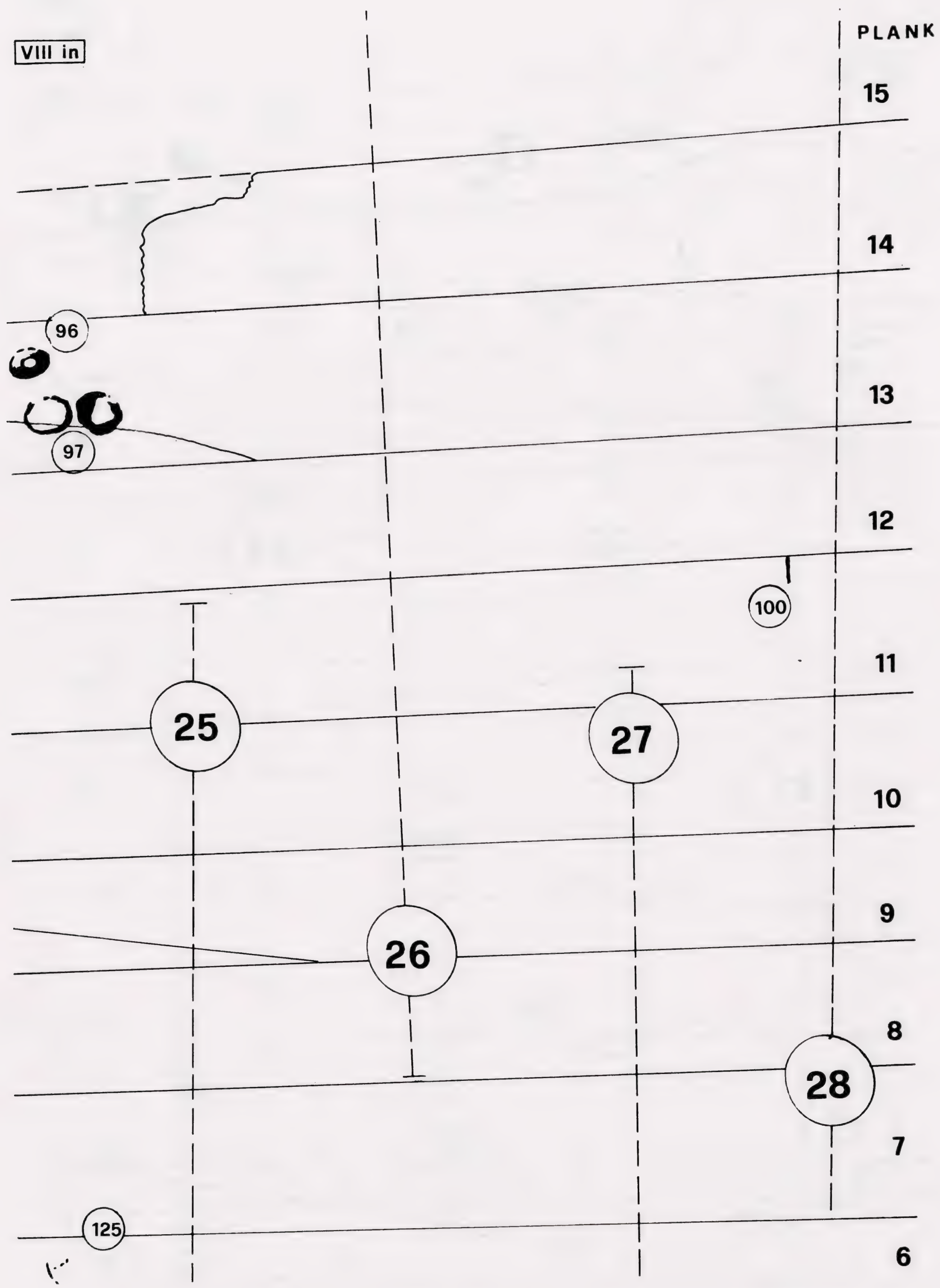


Fig. 120. - The interior of the ship: floor-timbers 25 and 27, ribs 26 and 28, strakes 6-15 port with associated signs.

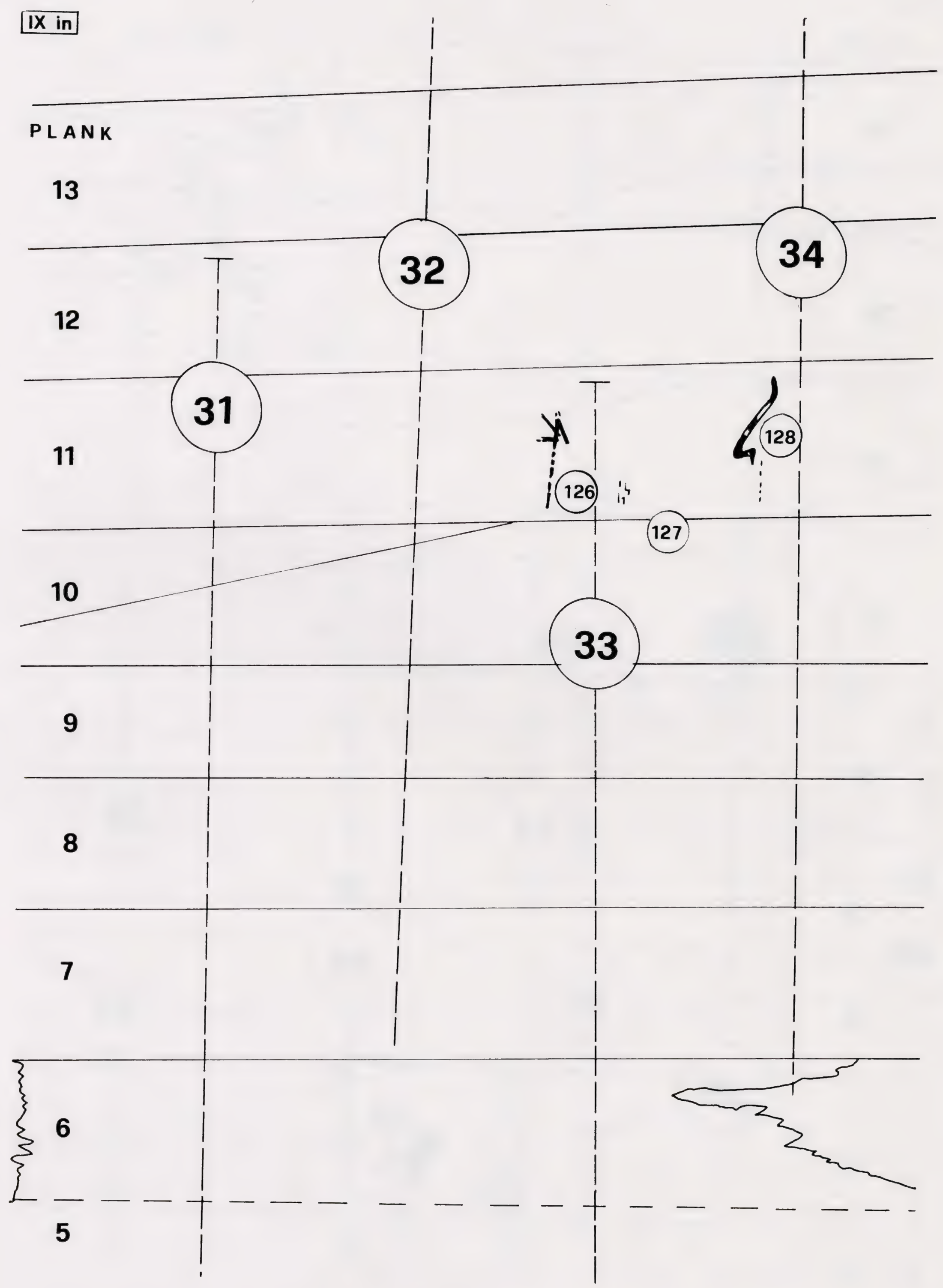


Fig. 121. - The interior of the ship: floor-timbers 31 and 33, ribs 32 and 34, strakes 5-13 port, with associated signs.

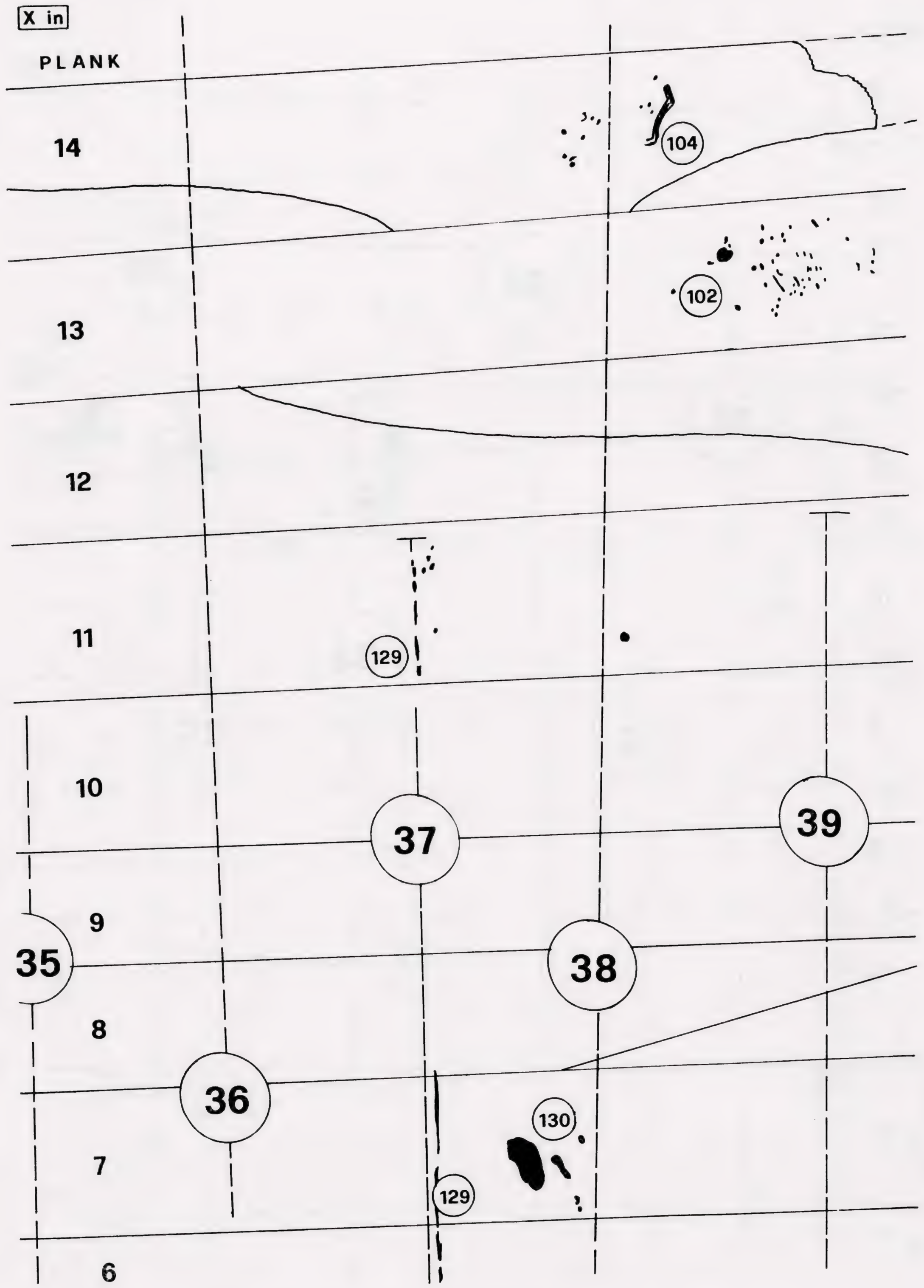


Fig. 122 *a*. - The interior of the ship: floor-timbers 35-39, ribs 36 and 38, strakes 6-14 port, with associated signs.

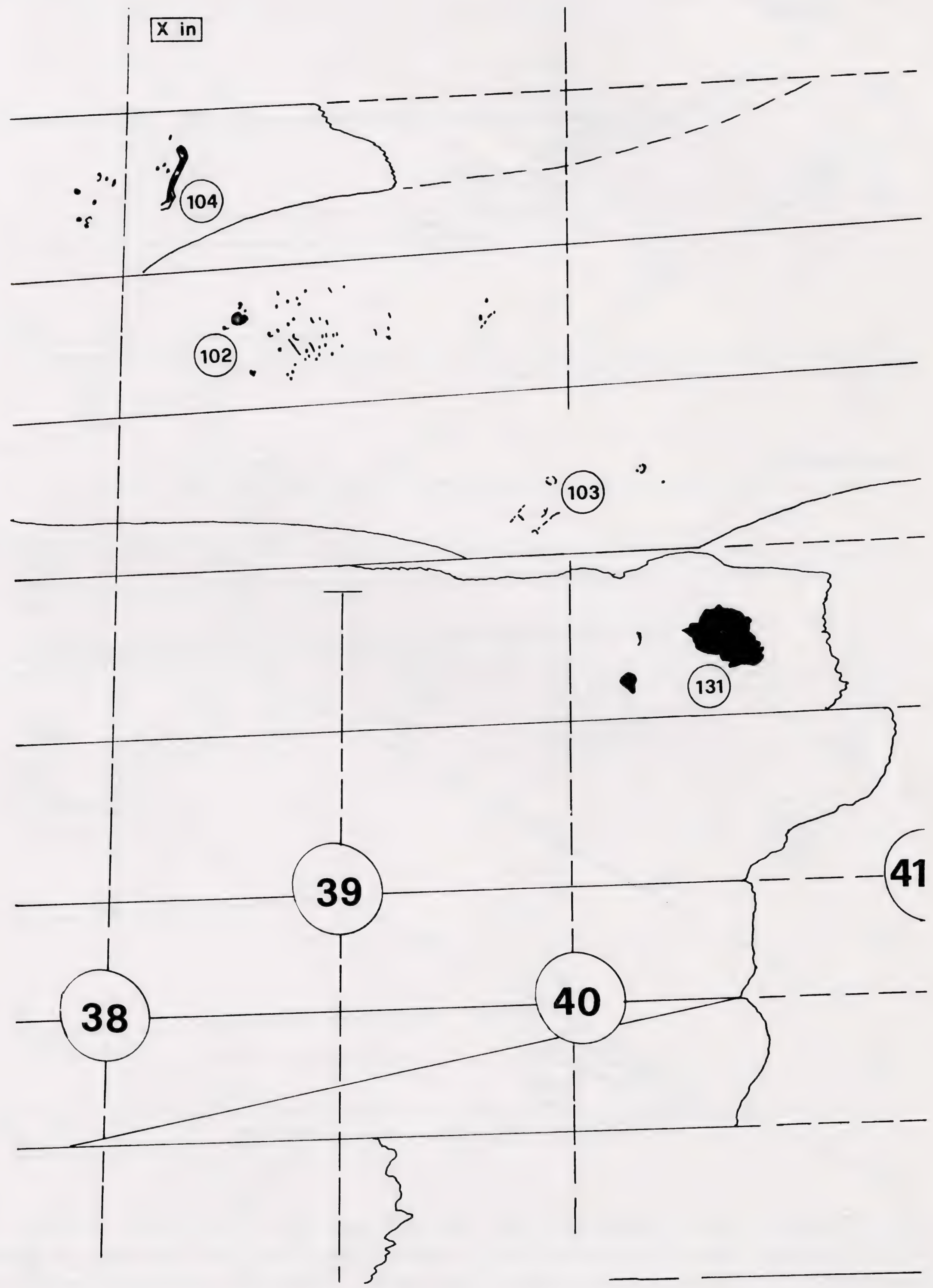


Fig. 122 *b*. - The interior of the ship: ribs 38 and 40, floor-timbers 39 and 41, strakes 7-14 port, with associated signs.

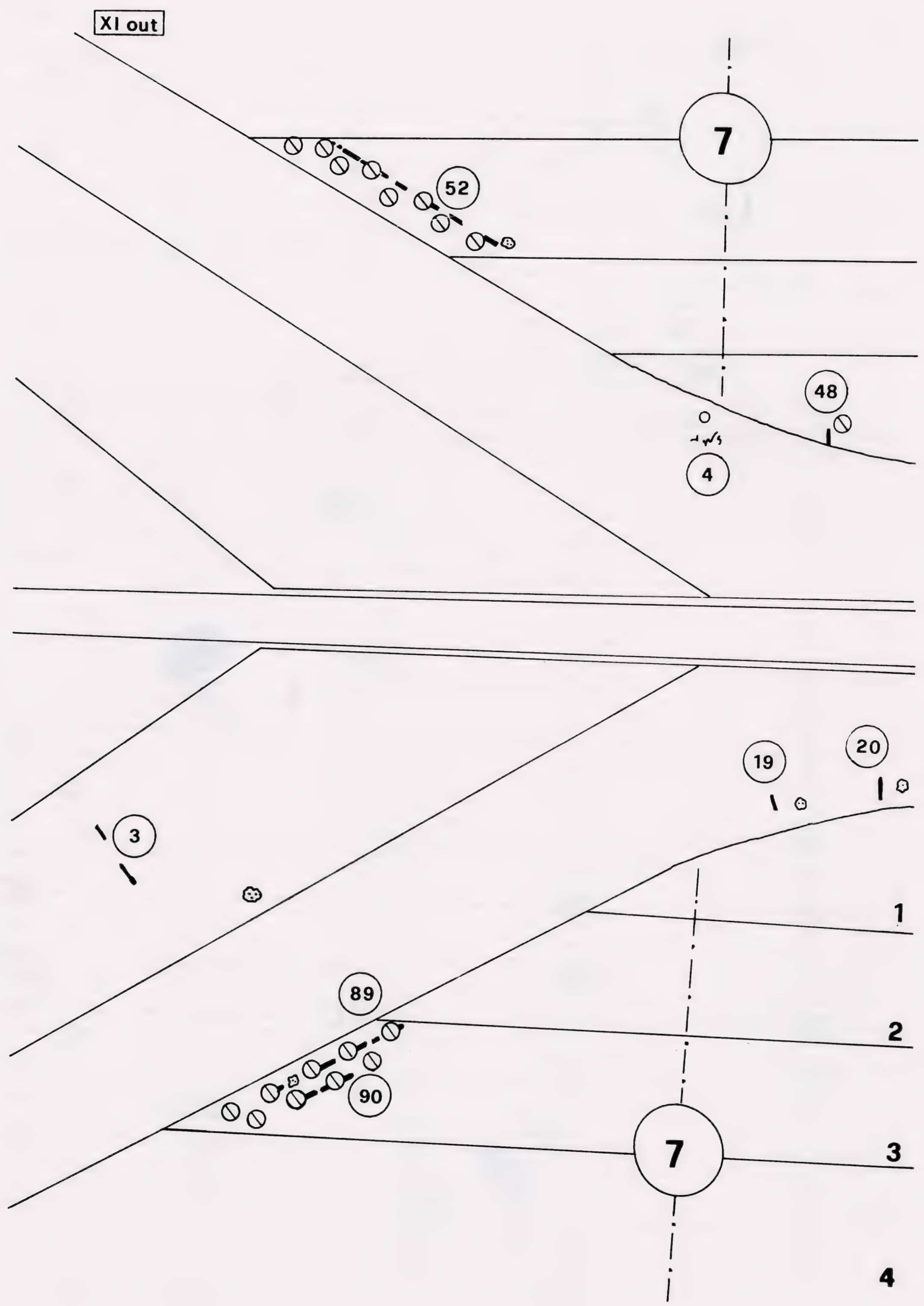


Fig. 123 *a*. – The exterior of the ship: the stern, strakes 1–4 starboard (above) and port at seating of floor-timber 7, with associated signs.

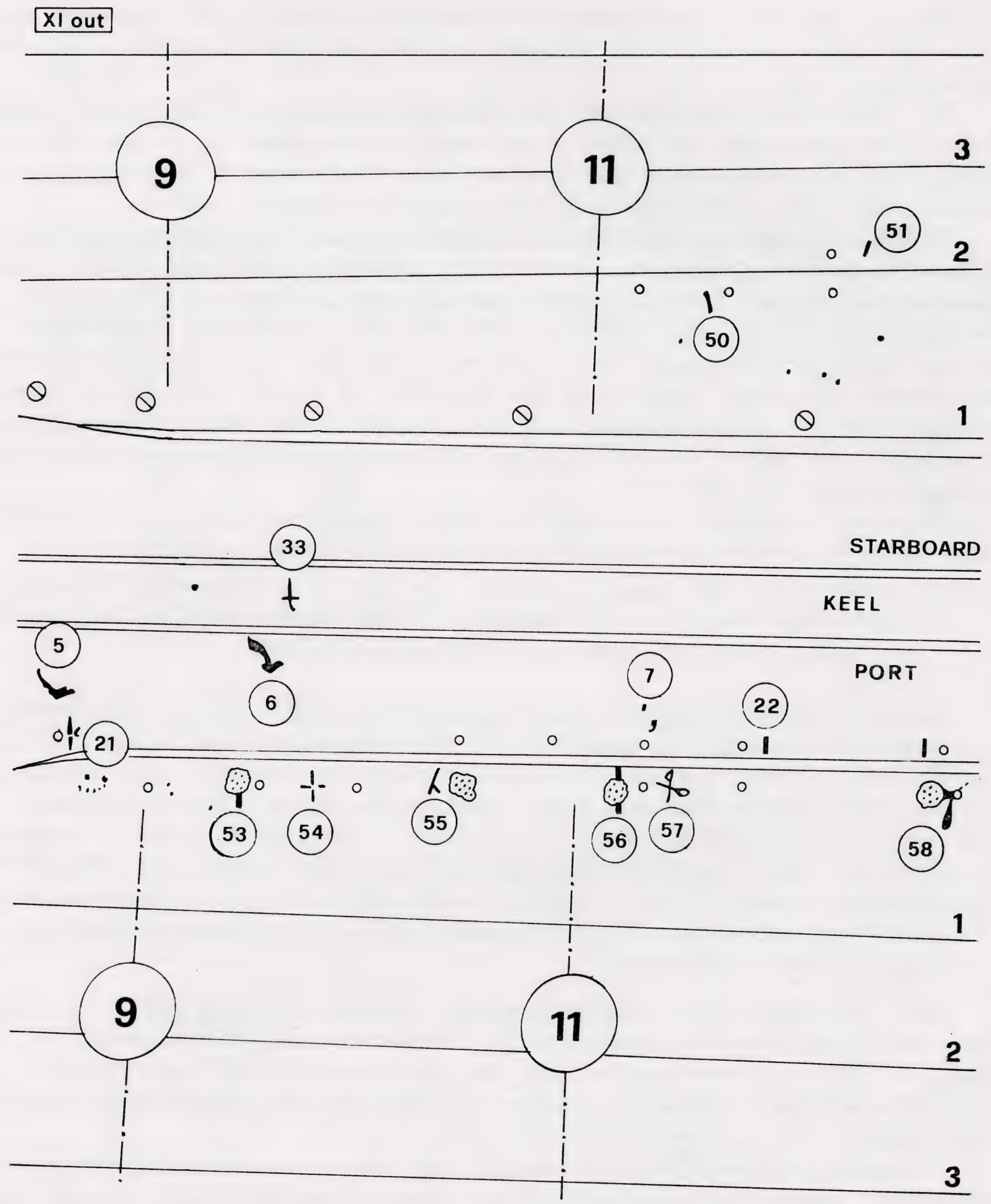


Fig. 123 *b*. – The exterior of the ship: strakes 1–3 starboard (above) and port at the seating of floor-timbers 9 and 11, with associated signs.

the complex 'bird's foot' sign (40) (figs. 117 and 134) between the seatings of floor-timbers 25 and 27, all point to the location of nails securing the port garboard to the port rabbet on the top of the keel. These signs cross to the starboard side of the central line on both sides of the seating of floor-timber 23, and there they do in fact point to the location of nails securing the starboard garboard in the starboard rabbet on the top of the keel.

Sign (42) (fig. 117), which crosses the central line forward of the seating of floor-timber 25, marks the place where the garboard scarf rises from the keel on both port and starboard.

The ' bird's foot ' sign (41) (fig. 116) between the seatings of floor-timbers 19 and 21 may also point to the place where a nail was to be hammered in to secure the port garboard to the port rabbet on the top of the keel. The bottom of the port garboard is, however, broken off at this point so that this suggestion cannot be verified.

' Bird's foot ' sign (43) (figs. 116 and 134) does not point to a nail securing the port garboard to the keel. It demands an alternative explanation which may, indeed, be more plausible for (41) also. It is to be noted that (41) and (43) stand on either side of the keel scarf, a point of possible weakness in the ship, and on either side of floor-timber 19, the floor-timber with the highest rise, as has been noted above. (41) and (43) may, therefore, refer to the nailing in position of ribs 18 and 20. It is to be noted in corroboration that rib 20 has an answering sign (A 118) at its seating on the interior of strake 8 port. Thus some or all of the ' bird's foot ' signs may reflect forward planning on the keel of the positioning of the ribs.

There may be listed as an appendix to this section a sign which was detected underwater but of which no trace remained at the time of the on-land examination:

A 43 – another ' bird's foot ' sign on the top of the keel aft of the seating of floor-timber 13; this sign did point to the location of a nail (at sign (58) [fig. 124]) securing the port garboard to the port rabbet on the top of the keel.

It may be suggested that the starboard garboard was fitted before its port equivalent. The support for this suggestion comes from the paint splashes (44) (figs. 116 and 135) on the port side of the forward keel timber: these seem to match no sufficiently large-scale painting of signs on the exterior of the port strakes above, but may more plausibly be related to the paint marks on the top of the keel and on the interior of the starboard strakes. It may be, therefore, that, while construction was going forward on the starboard side, the port side remained open, at least initially. The signs on the port side of the central line on the top of the keel may, indeed, only have been marked vis-à-vis the starboard garboard once the latter had been placed in position.

§ 2.6. *The fitting of the starboard garboard.* That the starboard garboard may have been the dominant one may be confirmed by the fact that the incised inverted ' V ' (45) (figs. 117 and 136), seemingly marking the place where the first nail forward of the garboard scarf is to be driven in to secure the garboard to the rabbet on the top of the keel, appears on the starboard side of the keel.

Thereafter, the fitting of the starboard garboard seems to have proceeded without undue deliberation; compared with the port garboard, there is a relative paucity of marks on it. This may, indeed, be further indication that it was fitted first. There is a tick (48), which may, however, be accidental, on its exterior between the seatings of floor-timbers 7 and 9, associated with the hammering in of a fixing nail (fig. 123).

It is in place to repeat that the paint spill (119) between the seatings of floor-timbers 19 and 21 on the interior of the starboard garboard only occurred after the starboard garboard had been fitted into the keel rabbet. This is another indication that the starboard garboard had already been fitted early on in the process of the construction of the ship.

§ 2.7. *The fitting of strakes 2 and 3 starboard.* The strakes were joined to each other by means of mortises and tenons. Two ticks (50) and (51) at the edge of mortises on the

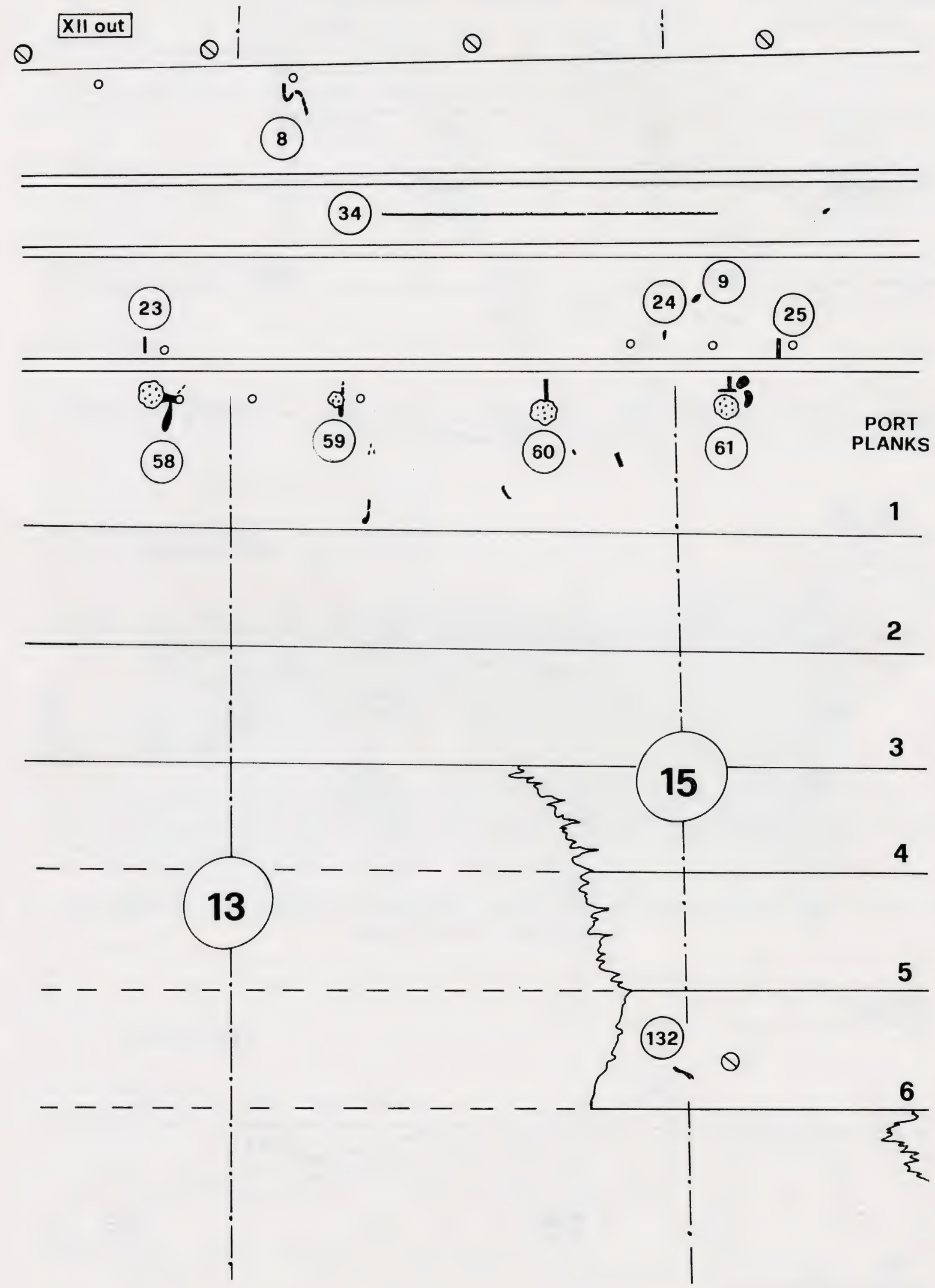


Fig. 124. – The exterior of the ship: strakes 1–6 port at the seating of floor-timbers 13 and 15, with associated signs.

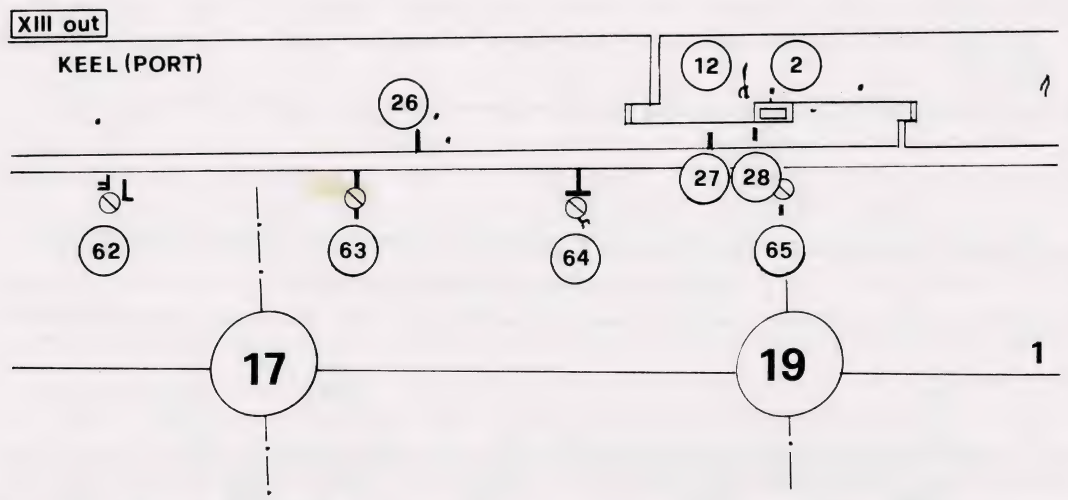


Fig. 125. – The exterior of the ship: keel scarph, port garboard at the seating of floor-timbers 17 and 19, with associated signs.

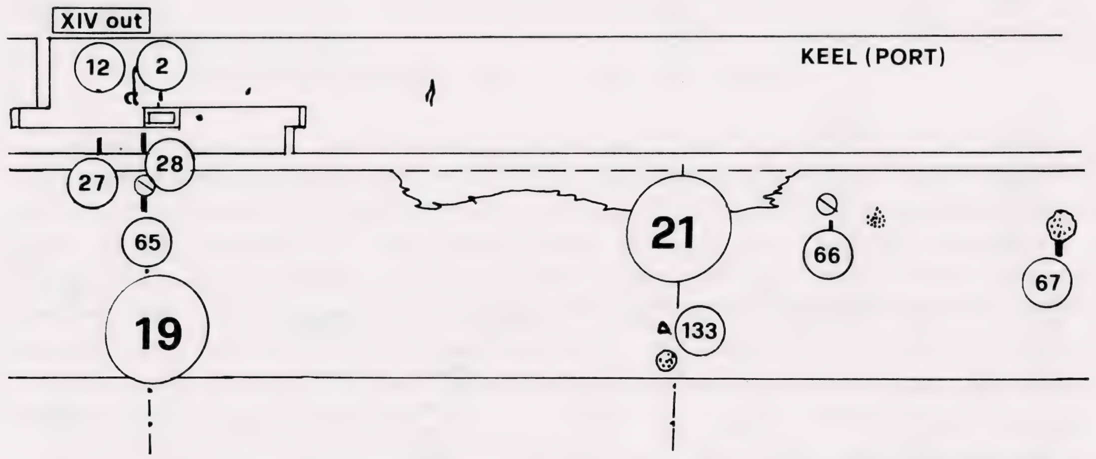


Fig. 126. – The exterior of the ship: keel scarph, port garboard at the seating of floor-timbers 19 and 21, with associated signs.

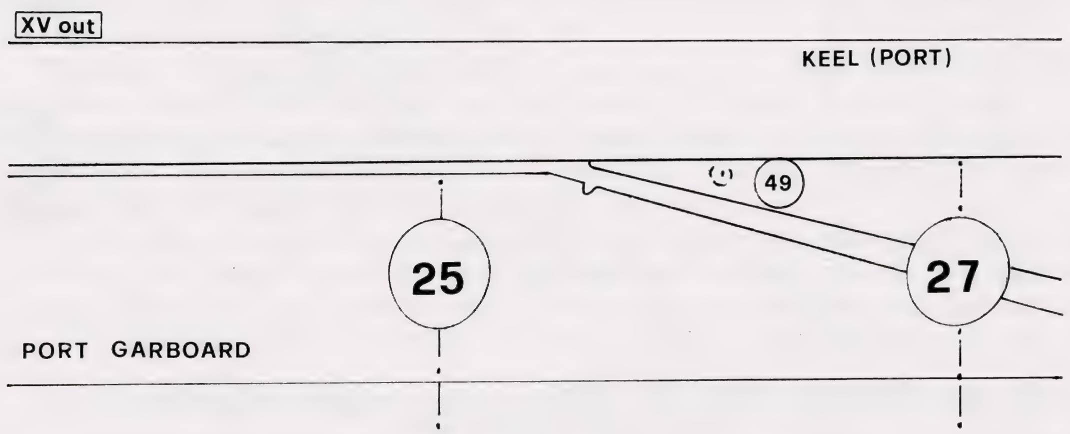


Fig. 127. – The exterior of the ship: port garboard scarph between the seatings of floor-timbers 25 and 27.

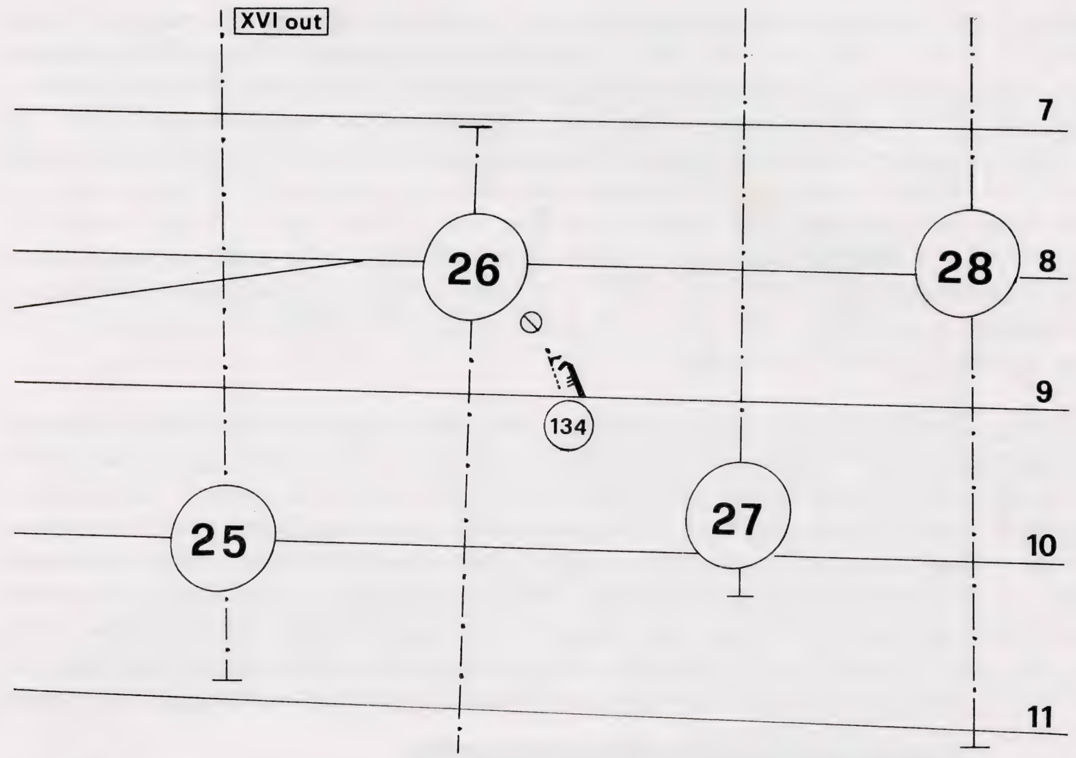


Fig. 128. – The exterior of the ship: strakes 7–11 port at the seating of floor-timbers 25 and 27 and ribs 26 and 28 with associated sign.

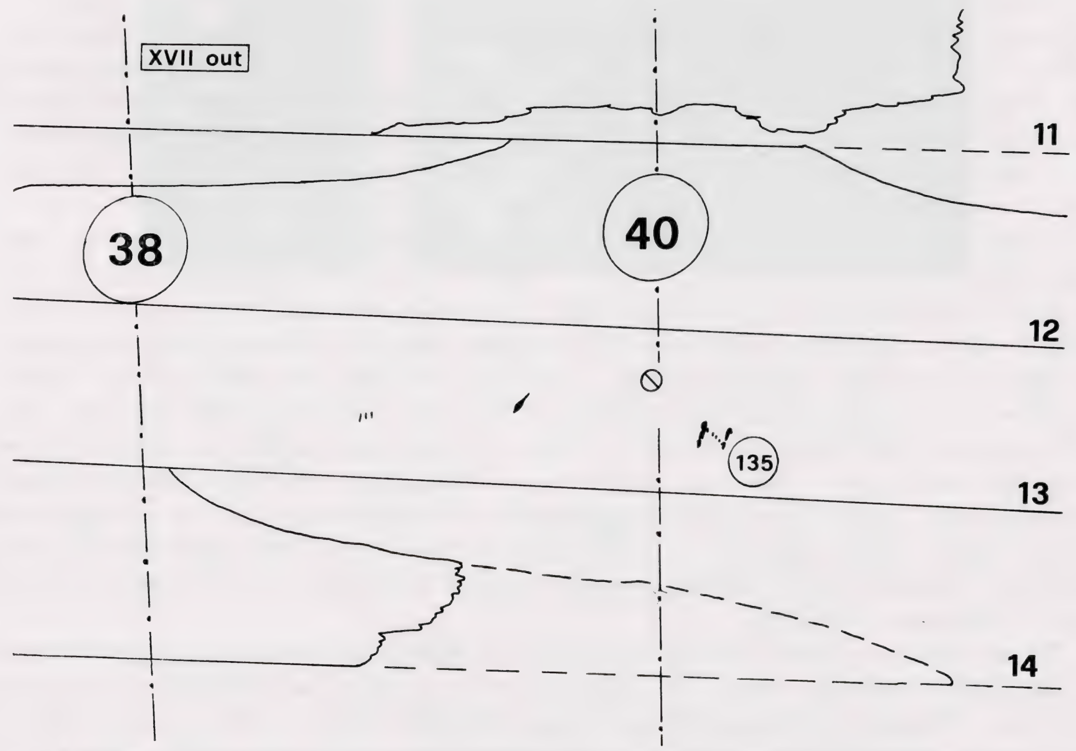


Fig. 129. – The exterior of the ship: strakes 11–14 port at the seating of ribs 38 and 40, with associated signs.

exterior of the starboard garboard and of strake 2 starboard between the seatings of floor-timbers 11 and 13 (fig. 123) are all the evidence that remains of the fitting together of the higher strakes on the starboard side. That strakes 2 and 3 were attached independently and not as a prefabricated unit seems to be indicated by the painted guide-line (52) (fig. 123) for the insertion of the fixing nails at the extreme after end of the exterior of strake 3 starboard, which is confined to that strake and does not continue down onto strake 2 as would have been expected had these two strakes been joined prior to being attached to the garboard. Analogous evidence for the independent fitting of at least the lower strakes comes from the port side of the ship. Blots (115) (figs. 116 and 143) between the seatings of floor-timbers 19 and 21 on the interior of strakes 3 and 4 starboard are posterior to the fitting together of these two strakes.

§ 2.8. *The fitting of the port garboard.* It has been suggested above that it was only once the starboard garboard had been fitted that the signs were painted on the top of the keel to show the location of the garboard scarf and the appropriate places to hammer in the nails to secure the port garboard to the port rabbet on the top of the keel. The position of some of these nails (and, apparently, some of the mortises) has been similarly carefully plotted on the lower part of the exterior of the port garboard by means of some fourteen painted ticks or crosses (53, 55–67) (figs. 123–126, 130 and 137) (the exception in this series, (54) [figs. 123, 130 and 137], seems to correspond to the painted cross (33) [figs. 115 and 130] on the top of the keel which, as noted above, marks the beginning of the upward turn of the keel to the stern-post).

§ 2.9. *The attaching of the higher port strakes.* The only evidence on the port garboard of preparation for the fitting of strake 2 port to it is tick (68) (fig. 116) on the upper edge of its interior between the seatings of floor-timbers 21 and 23. On the interior of strake 2 port there are some nine ticks (69–77) (figs. 110 and 116) on its lower edge between the seatings of floor-timbers 17 and 23 roughly corresponding to the sides of mortises and at least another eleven similar (78–88) (fig. 115) on its interior upper edge between the seatings of floor-timbers 7 and 13. In the latter series, some five pairs (78-79, 80–81, 82–83, 84–85 and 86–87) are linked at the bottom by loops, or the suggestion of loops, roughly corresponding to the bottom curve of the mortise concerned.

Strakes 1–3 port were perhaps attached each independently to the side of the ship rather than as a prefabricated unit: it is to be noted that the two guidelines (89) and (90) (fig. 123) for the insertion of nails at the after end of the exterior of strake 3 port do not extend down over strake 2 (cf. mark 52 on the starboard side). On the other hand, the squiggle (91) (figs. 110 and 116) opposite the top of the keel scarf has been drawn on the interior of strakes 2 and 3 port across their junction; it also has a matching splash (93) (fig. 116) on the interior of the port garboard; i.e., strakes 1–3 port had already been joined before the squiggle was drawn. They may indeed have already been attached to the ship before the squiggle was applied. It is not clear, therefore, that the function of the squiggle was to help to locate strakes 1–3 port as a unit correctly vis-à-vis the keel scarf: rather it may have been a reminder of the need to insert the longest floor-timber (floor-timber 19) at this point of structural weakness.

There appear to be only two further groups of signs which concern the assembling of the port side of the ship. These are (93)–(99) and (102)–(104) on the interior of strakes 12–14 port. The gap in the application of signs between strakes 3 and 11 port is indeed notable and suggests that the addition of these strakes proceeded uneventfully. Signs (93)–(104), however, may suggest that strakes 12–14 port were made as a prefabricated unit

before being attached to the side of the ship, a procedure that would hardly be surprising given the complicated scarfing on these strakes.

It seems evident that these strakes had been joined together when these groups of signs were made. Between the seatings of rib 18 and rib 26, the paint spots of the first group (93–99) (figs. 119, 120 and 138) are in clusters which span strakes 12 (perhaps even strake

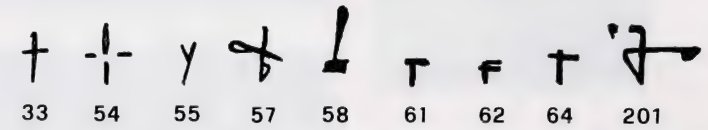


Fig. 130. – Varieties of cross.

11 aft of the scarf on that strake) and 13. Furthermore, the S-shaped scarf on strake 13 had already been made since one of the circles of paint (97) sits astride it. Yet it seems unlikely that these paint marks were made when the timbers had already been attached to the side of the ship. The marks (93), just aft of the seating of rib 20 on strake 13, and (95), between the seating of rib 20 and floor-timber 21 on strake 12, may well have been left by the base of the paint-pot (*ca.* 10 cm. in diameter?). If so, these timbers must have been in a horizontal, or near-horizontal, position when these marks were made. The spots forward of each may represent the spray of the charged brush as it was being moved forwards and slightly upwards to make the circles (94), (96) and (97) on the forward scarfed timber of strake 13.

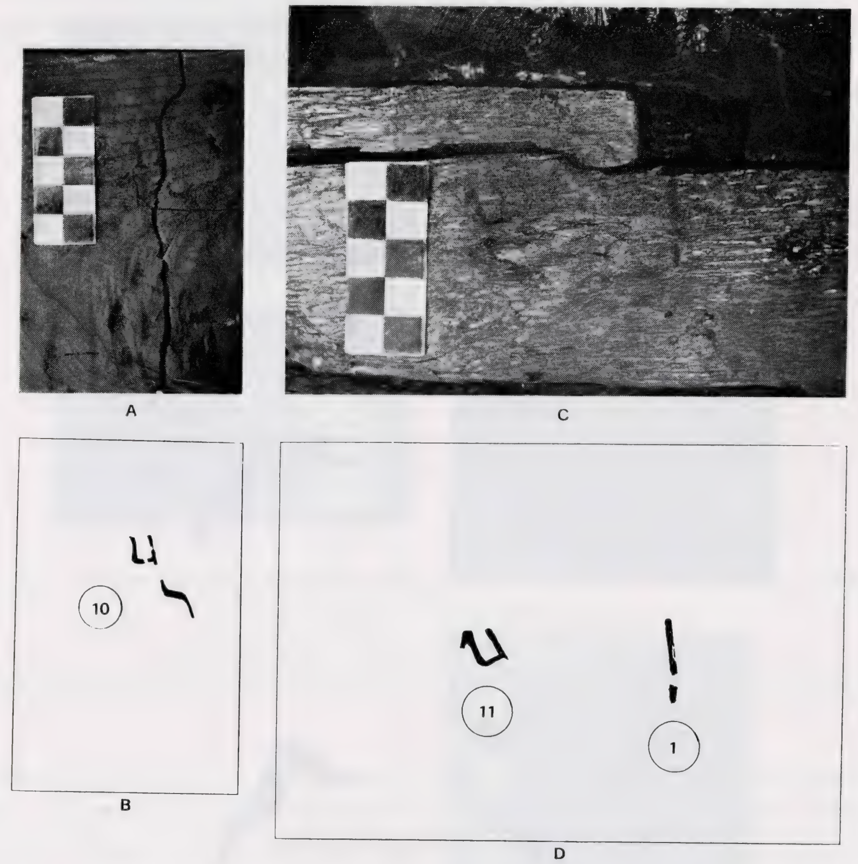


Fig. 131. – Marks (1), (10), and (11) on the starboard face of the keel near the keel scarph (photographed on land).

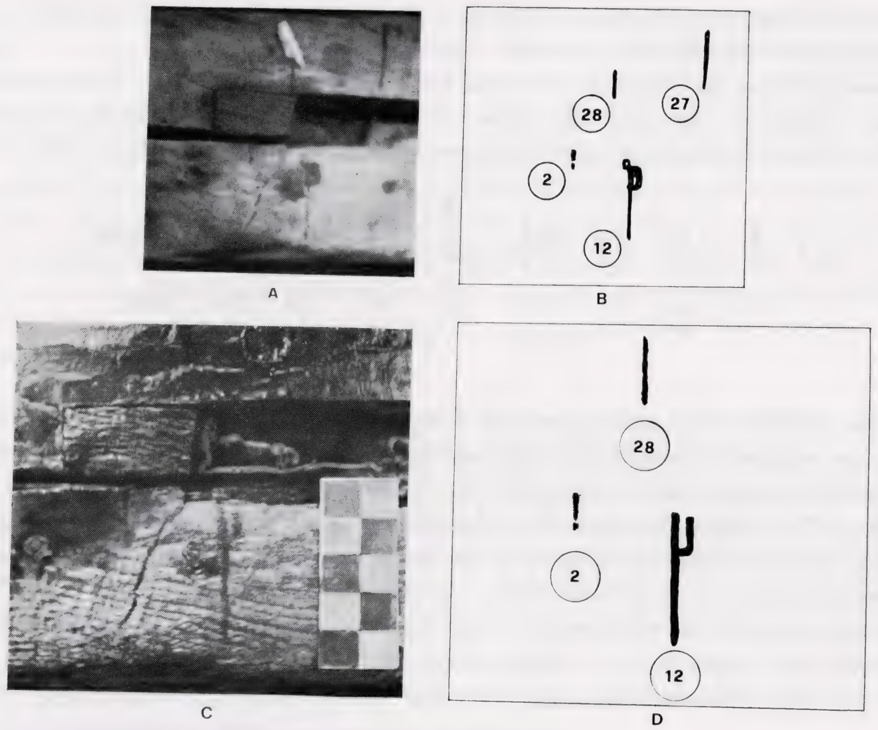


Fig. 132. - Marks (2), (12), (27), and (28) on the port face of the keel at the keel scarph: A-B as photographed underwater; C-D as photographed on land.

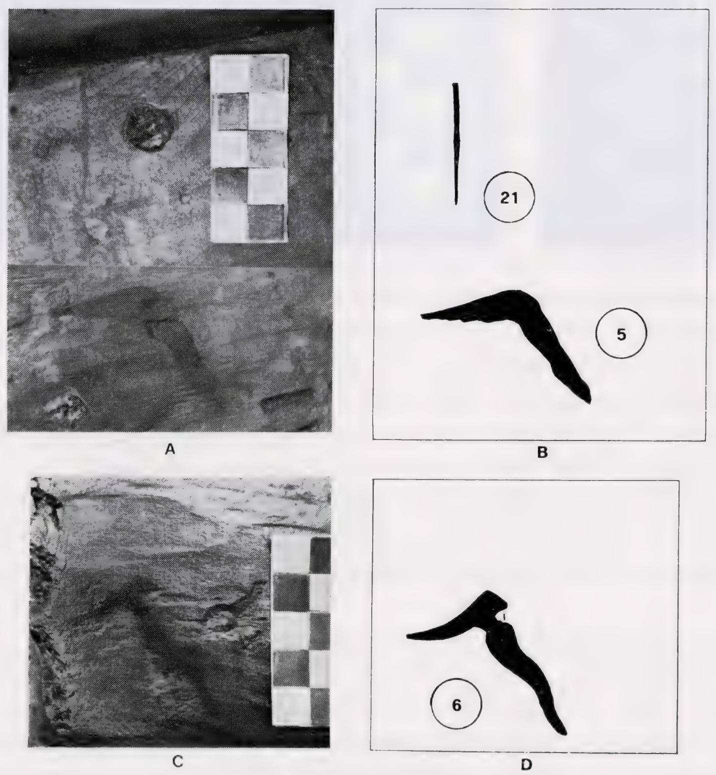


Fig. 133. - Marks (5), (6), and (21) on the port face of the keel near the seating of floor-timber 9 (photographed on land).

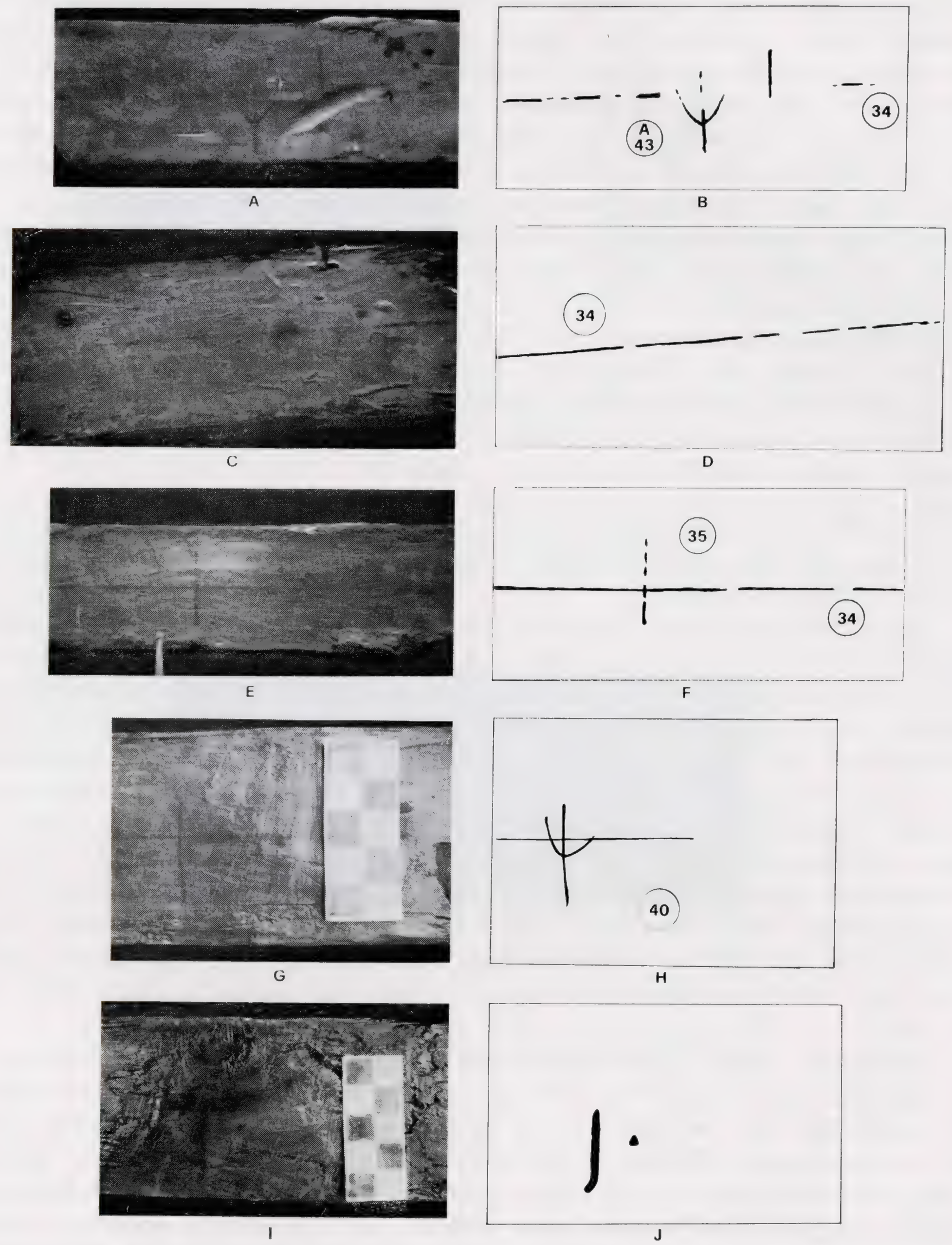


Fig. 134. - The line (34) and marks (35), (36), (40) and (A43) on the top of the keel between the seatings of floor-timbers 21-27:

A-F photographed underwater; G-J photographed on land.

(Plate VI (i) in the article in *PEQ* 109, 1977, pp. 95 ff. should be amended in the light of GH above).

While the circle (94) forward of the seating of rib 22 on strake 13 appears to have been painted, it is not clear that this is so of all of the group forward of the seating of rib 24 on the same strake: the lower forward one has a large concretion attached to it and cannot, therefore, be made purely by paint. There appears to be yet another mark from the base of the paint-pot (98) aft of the seating of floor-timber 19 on strake 13.

There are ticks (101) at the sides of mortises on the lower edge of the inside of the fragmentary strake 15 between the seatings of ribs 18 and 20. There is no indication of whether strake 14 as the upper strake of a prefabricated section had already been attached to the side of the ship by the time strake 15 was attached to it, though this is a possibility. The tick (100) at a mortise on the top edge of the inside of strake 11 port just aft of the seating of rib 28 may similarly be evidence of the attachment of the postulated prefabricated section to the part of the side of the ship that had already been constructed.

(102)–(104), the second group of marks on the interior of strakes 12–14 port (figs. 122 and 139), this time at the place where ribs 38 and 40 cross two short planks each ending with two opposed S-shaped scarfs, seems to support the contention that strakes 12–14 constituted a prefabricated unit. The denser mark (102) on strake 13 surrounded by a spray of spots may indicate that the paint-pot was placed on that strake while signs (103) and (104) were painted on strakes 12 and 14 respectively. If this is so, then it indicates once again that these timbers must have been in a horizontal, or near-horizontal, position when these marks were made.

§ 2.10. *The paint marks associated with the fitting of the floor-timbers and the ribs.* As has been stated, the floor-timbers/ribs were only fitted once the relevant strakes had already been placed in position.

To judge from the scored guide-lines, the operation of inserting the floor-timbers/ribs must have included the following stages. A floor-timber/rib was placed in the position predetermined for it from the forward planning on the keel (this position is sometimes noted in paint at a suitable point or points on the planks which the floor-timber/rib will traverse); guide-lines were then scored along either side of the floor-timber/rib onto the strakes which it was to span; the floor-timber/rib was then removed, and dowel holes pierced through it at intervals roughly corresponding with the centre of each strake that it crossed; putty (acting as a filler and an adhesive) was then smeared over the bottom of the floor-timber/rib before it was repositioned between the scored lines and the borings continued through the hull planking; dowels were then inserted into these holes from the outside of the ship and nails driven through them, "rawlplugging" them into position; inside the ship, the ends of these nails which protruded from the top of the floor-timber/rib, were then clinched down into it.

A preliminary study of the scored guide-lines also indicates that the building of the sides of the ship and the inserting of the floor-timbers/ribs were done in alternating stages. It is a notable fact that the guide-lines for the location of the floor-timbers do not rise above strake 11 port, except in the case of floor-timbers 19, 21 and 31. In the case of floor-timber 19, it may be that the guide-line on strake 12 represents a later, and rather maladroit, attempt to continue the guide-lines from the lower stakes. The suggestion is, therefore, made that the floor-timbers were inserted when the sides of the ship had risen to strake 11. Only when the higher strakes (perhaps, in part, in prefabricated sections) had been added were the ribs inserted with additional scoring of seatings and nailing up of floor-timbers, 19, 21 and 31, as required. Contrariwise, there is a ' correction ' of the guide-line of rib 34 also on strake 11, which may indicate that preliminary location of the ribs took place when the sides were completed up to strake 11, their position being finally fixed only when further strakes had been added. That is, there is to be seen here the same process of planning ahead, building, and fitting, as has already been noted in connection with the floor-timbers.

This view that there was an alternating process in the building up of the sides and the insertion of the floor-timbers/ribs receives support from the paint marks—the writing of

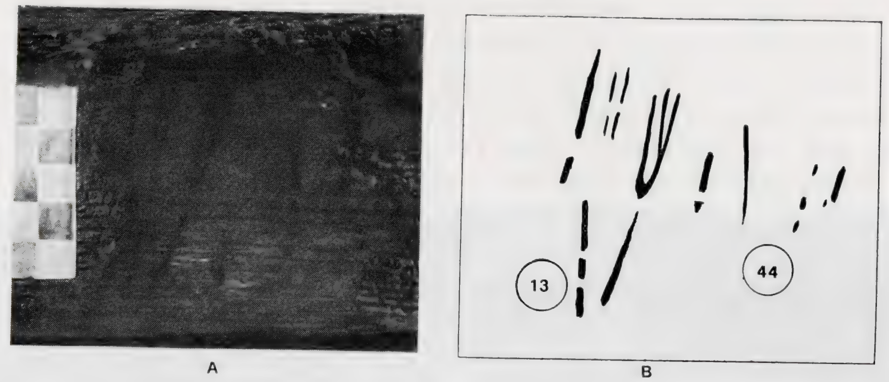


Fig. 135. – Marks (13) and (44) on the port face of the keel near floor-timber 21 (photographed on land).

some of them ' upside down ' and the use of strake 11 as the key to the order of sequence of the floor-timbers/ribs in their series – as will be seen below.

A considerable number of painted signs were used in connection with the operation of fitting the floor-timbers/ribs.

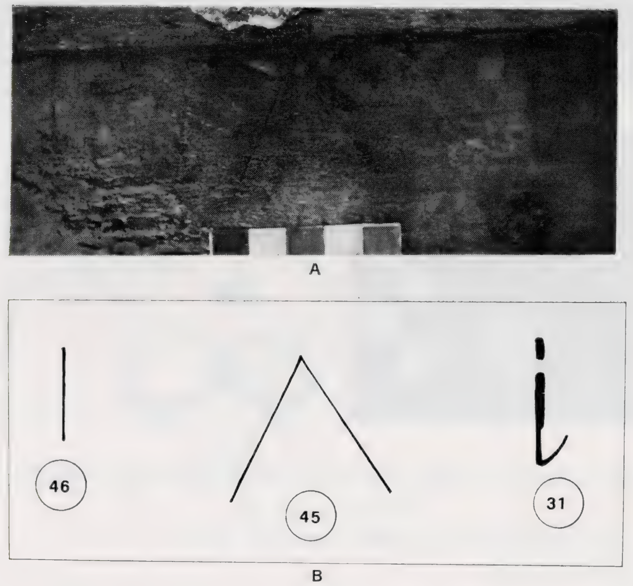


Fig. 136. – Marks (31), (45), and (46) on the starboard face of the keel at the garboard scarph (photographed on land).

Ticks were painted on the sides of a number of the floor-timbers/ribs vertically to their lower edge at the location of the dowels which were to be fitted into the corresponding holes in the strakes; *e.g.*, rib 18 has eleven dowels on its lower edge; ticks marking their place are visible on its side from the third to the sixth dowel from the top. These ticks are judged to be among the last of the marks to be applied in that part of the ship which is now extant and have therefore been numbered indeterminately (136 ff.) at the end of the general series (though those on the floor-timbers would be applied before those on the ribs).

It has been argued above that already at the time of the laying-down of the keel the positioning of the floor-timbers/ribs, especially vis-à-vis the keel scarf, and their spacing were being roughed out by means of the paint marks on the sides of the keel. Thus the location of floor-timbers 7, 13, 17 and 19 was fixed by means of signs (4) (figs. 114 and 140), (8) (figs. 115 and 141), (10) and (11) (figs. 116 and 131) on the starboard side of the keel, while that of floor-timber 9 was indicated by signs (5) and (6) (figs. 115 and 133), and that of floor-timber 19 by sign (12) (figs. 116 and 132) on the port side of the keel. It is not

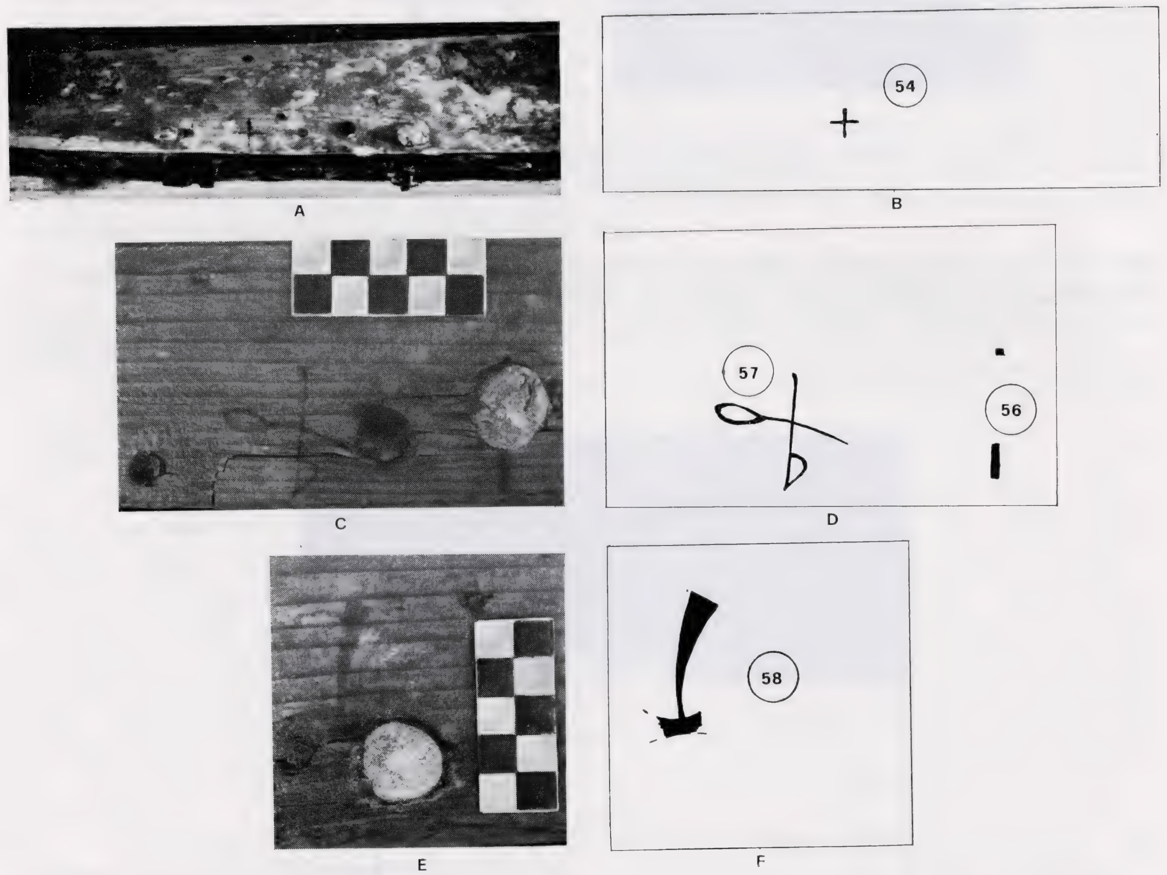


Fig. 137. – Marks (54) and (56)–(58) on the exterior of the port garboard between the seatings of floor-timbers 9 and 13:

A-B photographed on land immediately on being raised in 1971;

C-F photographed on land in 1973.

clear why the location of floor-timber 9 is marked by two signs [(5) and (6)]. It may again have something to do with the fact that the rise of the keel towards the stern-post occurs about this point. It is to be noted that signs (5) and (6) are matched by sign (106) (figs. 112 and 115) at the seating of floor-timber 9 on the interior of strake 2 port. Paint marks (7), (9) and (13)–(16) (figs. 115–118 and 135) may represent vestiges of similar signs at the locations of floor-timbers 11, 15, 21, 23, 25 and 31. It is possible that marks (14) and (15), since they occur between, rather than at, the seatings of floor-timbers, refer to the location of ribs 24 and 26.

Possibly some marks on the top of the keel refer to the location of floor-timbers. The possibility that tick (32) (fig. 116) may be associated with the location of floor-timber 21

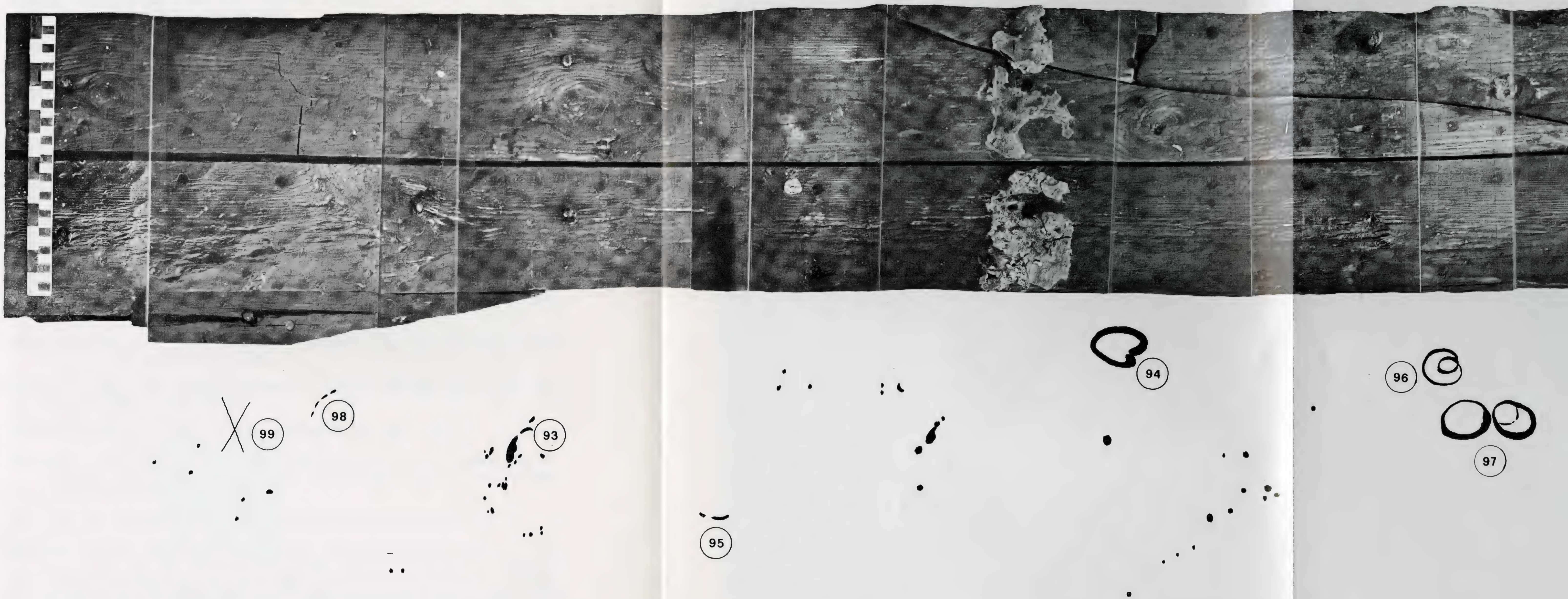


Fig. 138. – Marks and splashes (93)–(99) on the interior of strakes 12–13 port between the seating of ribs 18 and 26 (photographed on land).

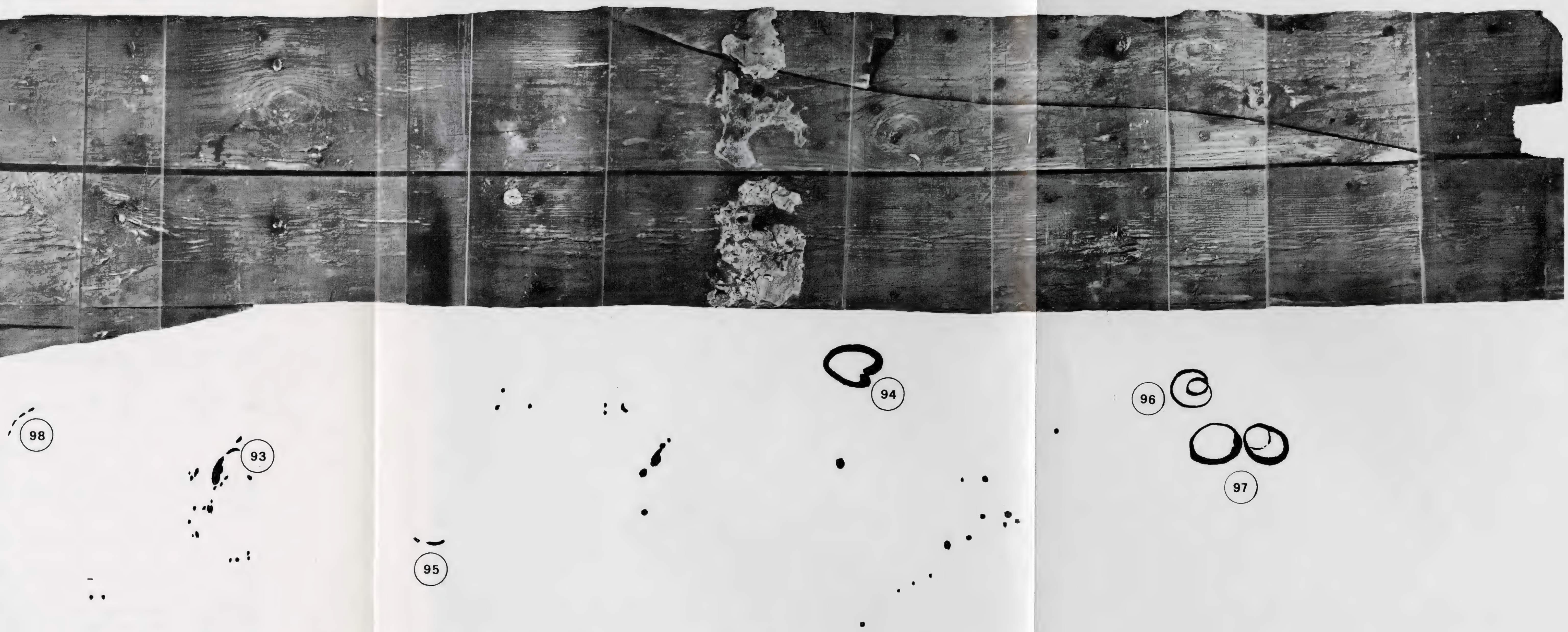


Fig. 138. – Marks and splashes (93)–(99) on the interior of strakes 12–13 port between the seating of ribs 18 and 26 (photographed on land).

has been mentioned above. There appears to be a sign (17) (fig. 118) on the top of the keel, with associated marks (16) on the port face of the keel, about the site of floor-timber 31. It should be remembered that the wood here, towards the forward end of the extant part of the keel, is already worn and that, therefore, the marks are unlikely to have been preserved, in their full original forms. It is not clear whether the paint mark (18) (fig. 116) on the top of the keel immediately forward of the seating of floor-timber 17 is a sign, or whether it is merely accidental.

It would appear that during the construction of the sides of the ship signs marking the position of floor-timbers/ribs were transcribed from the keel to suitable points on the interior of especially the lower strakes; the cases of floor-timber 9 and rib 20, which have been noted above, are particularly clear. As in the case of the ticks marking the edge of mortises, so it is to be noted here that these signs are used only sporadically. If these signs were made during the course of the construction of the sides, then they obviously belong to a stage earlier than the scoring of the incised guide-lines down the interior of the sides of the ship to mark the seatings of the floor-timbers/ribs. The painted marks are thus preliminary notes concerning the positioning of the floor-timbers/ribs, an interpretation which is confirmed by the fact that many of the painted signs actually lie underneath the seatings of the floor-timbers/ribs and must therefore have been obscured by them once they were fitted. It is certain that there are signs under the putty still adhering to the side strakes at the seatings of floor-timbers/ribs (cf., *e.g.*, visible traces protruding from under the putty at the seatings of floor-timbers 17 and 19 on the interior of the port garboard [fig. 116]); it is, however, impossible to remove this putty, which is now as impervious as concrete, without damaging the fragile wood underneath.

The following is the complete list of the marks on the interior of the sides of the ship associated with the fitting of the floor-timbers/ribs:

floor-timber 9 (fig. 115) – signs on strakes 3 starboard (105) (fig. 142), 2 port (106) (fig. 112) and, possibly, 3 port (107);

floor-timber 11 (fig. 115) – splashes on strake 3 starboard (108) (fig. 142); spot at nail-hole on strake 3 port (109);

floor-timber 13 (fig. 115) – sign on strake 3 starboard (110) (fig. 111);

floor-timber 17 (fig. 116) – signs on strake 3 starboard (111) (fig. 142); possibly sign on starboard garboard (112); probably sign concealed under putty on port garboard (113); dash on strake 3 port (114);

rib 18 (fig. 119) – incised ' X ' (99) (fig. 138) between it and floor-timber 19;

floor-timber 19 (figs. 116 and 119) – probably only blots forward of it on strakes 2–3 starboard (115) (fig. 143); blot (116) suggests sign concealed under putty on starboard garboard; probably sign concealed under putty on port garboard (117); squiggle (91) (fig. 110) immediately forward of it on strakes 2–3 port; remnant of sign at nail on strake 9 port (118); mark interpreted as made by base of paintpot between floor-timber 19 and rib 20 is directly above the top of the keel scarf and, no doubt, could be the remnant of a sign (fig. 138);

floor-timber 21 (fig. 116) – marks aft of seating on strakes 1–3 starboard probably merely spills (119) (fig. 144); tick (120) at nail on port garboard; dash (121) above scarf on strake 5 port (fig. 119);

rib 22 (fig. 119) – painted guide-line (122) on strake 7 port; signs at scarf on strake 9 port (123) and at scarf on strake 13 port (94) (fig. 138);

floor-timber 23 (fig. 116) – sign (124) (fig. 145) on port garboard more likely, in view of considerations below, refers to rib 24;

rib 24 (fig. 119) – sign (125) on strake 6 port; signs (96) and (97) on strake 13 port (fig. 138);

floor-timber 33 (fig. 121) – sign (126) (fig. 146) and splash (?) (127) on strake 11 port;

rib 34 (fig. 121) – sign (128) (fig. 146) on strake 11 port;

floor-timber 37 (fig. 122) – painted guide-line (129) across strakes 6, 7 and 11 (and, presumably, also originally across intervening strakes 8-10) port;

rib 38 (fig. 122) – blot (130) on strake 7 port; sign (104) on strake 14 port;

rib 40 (fig. 122) – sign (103) (fig. 139) on strake 12 port;

floor-timber 41 (fig. 122) – blot (131) at upper extremity on strake 11 port.

There are also a few marks on the exterior of the sides of the ship associated with the fixing of the floor-timbers/ribs (the paucity of these marks confirms that the holes in the strakes to receive the dowels fixing them to the floor-timbers/ribs must have been bored from the inside of the ship):

floor-timber 15 (fig. 124) – dash (132) beside nail on strake 6 port;

floor-timber 21 (fig. 126) – mark (133) at nail on the port garboard;

rib 26 (fig. 128) – mark (134) at nail on strake 9 port;

rib 40 (fig. 129) – mark (135) at nail on strake 13 port.

For convenience, mention may be made at this point of the sign which may be conventionally numbered (201) (fig. 130), at a nail on the underside of an isolated ceiling plank (inventoried P9) which spans floor-timbers 17-31. This sign over floor-timber 21 appears to be a cross (or *taw*?). At the same place on the upper side of the timber there is a dash (202) and, on the edge of the timber where there is a small nail, a tick (203).

There may be also listed here as an appendix to this section signs which were detected under water but of which no trace remained at the time of the on-land examination:

A103 – a cross and a stroke (?) on the after side of sign (103) on the interior of strake 12 port (cf. fig. 139);

A118 (fig. 147) – a sign similar to (111) at the seating of rib 20 on the interior of strake 8 port.

Like another sign [(124)] probably also associated with a rib, (A118) is written 'upside down', i.e., to be read from above. These signs lend support to the view that the floor-timbers were inserted first 'from below' (when strake 11 had been reached) and the ribs only subsequently (where the side strakes rose higher) 'from above'. Sign (105) on the interior of strake 3 starboard is also written 'upside down' but it is probably a special instruction concerning the rise of the keel into the stern-post (see below); sign (111) on the interior of the same strake at the seating of floor-timber 17 is, at all events, written to be read 'from below'.

The remaining marks shown on figs. 114–119 which have not been itemised in this section are deemed for the most part to be accidental spots and splashes.

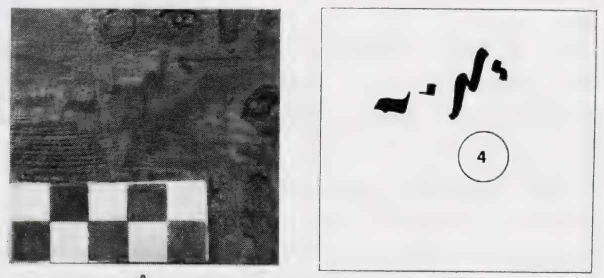
§ 2.11. *The significance of the painted signs associated with the seatings of the floor-timbers and ribs.* It is to be observed that many of the signs thus listed as associated with the seatings of floor-timbers and ribs are alphabetic, and that it is probably only in connection with the positioning of the floor-timbers and ribs that alphabetic signs are used.

A B

Fig. 139. – Marks (103) on the interior of strake 12 port at the seating of rib 40 (photographed underwater).

These facts must have some significance. It may be suggested that the reason for the use of the alphabetic signs is to order the sequence of the floor-timbers/ribs in a series in relation to one another. Yet once again the craftsman has had no need of an exhaustive use of signs!

It must be admitted that the evidence in support of this suggestion is not completely conclusive. It would appear to be beyond question that a number of these signs are derived from the Phoenicio-Punic alphabet: this is incontrovertibly true of signs 126 (*kap*) and 128 (*lamed*) (figs. 121 and 146) written at floor-timber 33 and rib 34 respectively on the interior of strake 11 port. The occurrence of two successive floor-timbers/ribs being marked by means of two successive letters of the Phoenicio-Punic alphabet raises the question whether all the floor-timbers/ribs were similarly lettered in series. Assuming that all twenty-two letters



A B

Fig. 140. – Marks (4) on the starboard face of the keel at the seating of floor-timber 7 (photographed on land).

of the Phoenicio-Punic alphabet were used, floor-timber 33 and rib 34 would then be numbers eleven and twelve in a sequence which began with floor-timber 23. Aft of floor-timber 23 to the assumed position of the sternpost, there would have been room to mark out on strake 11 port a complete antecedent series of twenty-two floor-timbers/ribs, in which case floor-timber 33 and rib 34 would have been the thirty-third and thirty-fourth cross-members

from the stern respectively (hence the numbering which has been adopted for the floor-timbers/ribs) [(6)].

If this hypothesis is sound (it would not be difficult to discern, *e.g.*, a *ṭet* at the seating of floor-timber 31 [fig. 148]), the reason for choosing strake 11 for marking out the sequence of the flood-timbers/ribs seems clear; it is the strake furthest from the keel which is still crossed, or at least touched, by both floor-timbers and ribs (the topmost nails securing floor-timbers 17, 23, 27 and 35 are actually on strake 10 port, but, even so, in the case of floor-timbers 27 and 35 there are traces of putty from their seating on the interior of strake 11).

One of the other floor-timbers/ribs certainly, and a second possibly, seems to fit into the postulated sequence. Floor-timber 19 on this theory would be the nineteenth frame

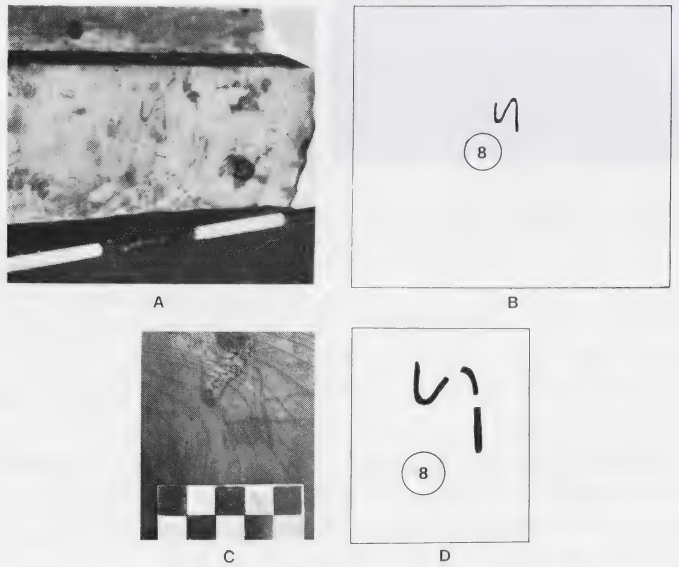


Fig. 141. - Mark (8) on the starboard face of the keel at the seating of floor-timber 13:
A-B photographed on land immediately on being raised in 1971;
C-D photographed on land in 1973.

from the stern, and it is indeed marked on the keel by *qop* (12) (figs. 116 and 132), the nineteenth letter of the Phoenicio-Punic alphabet. Rib 24 would be the twenty-fourth in the series and should therefore be marked by *bet* (*i.e.*, the second of the second series matching the number and order of the twenty-two letters of the Phoenicio-Punic alphabet): it may be that the *bet* (124) (figs 117 and 145) written ' upside down ' on the interior of the port garboard forward of the seating of floor-timber 23 refers then to rib 24 rather than to floor-timber 23. The reason for its being written 'upside down', *i.e.*, to be read from above, would thus find its explanation: it was a reminder about the positioning of a rib which was only inserted at a much later stage in the construction of the ship.

(6) The argument here depends on the validity of the assumption that the letters of the Phoenicio-Punic alphabet were arranged in a conventional order: this assumption is fully justified in the light of the discovery of, *e.g.*, Canaanite cuneiform alphabetic texts at Ras Shamra and Bethshemesh. Cf., *e.g.*, M. SZNYCER, *Quelques remarques à propos de la formation de l'alphabet phénicien*, *Semitica* 24, 1974, p. 10: «La controverse entre les partisans et les adversaires de l'ancienneté de l'ordre des lettres de l'alphabet phénicien ... fut tranchée: l'ordre des lettres ... remonte au moins jusqu'au XIV-XV siècle av. J.-C.».

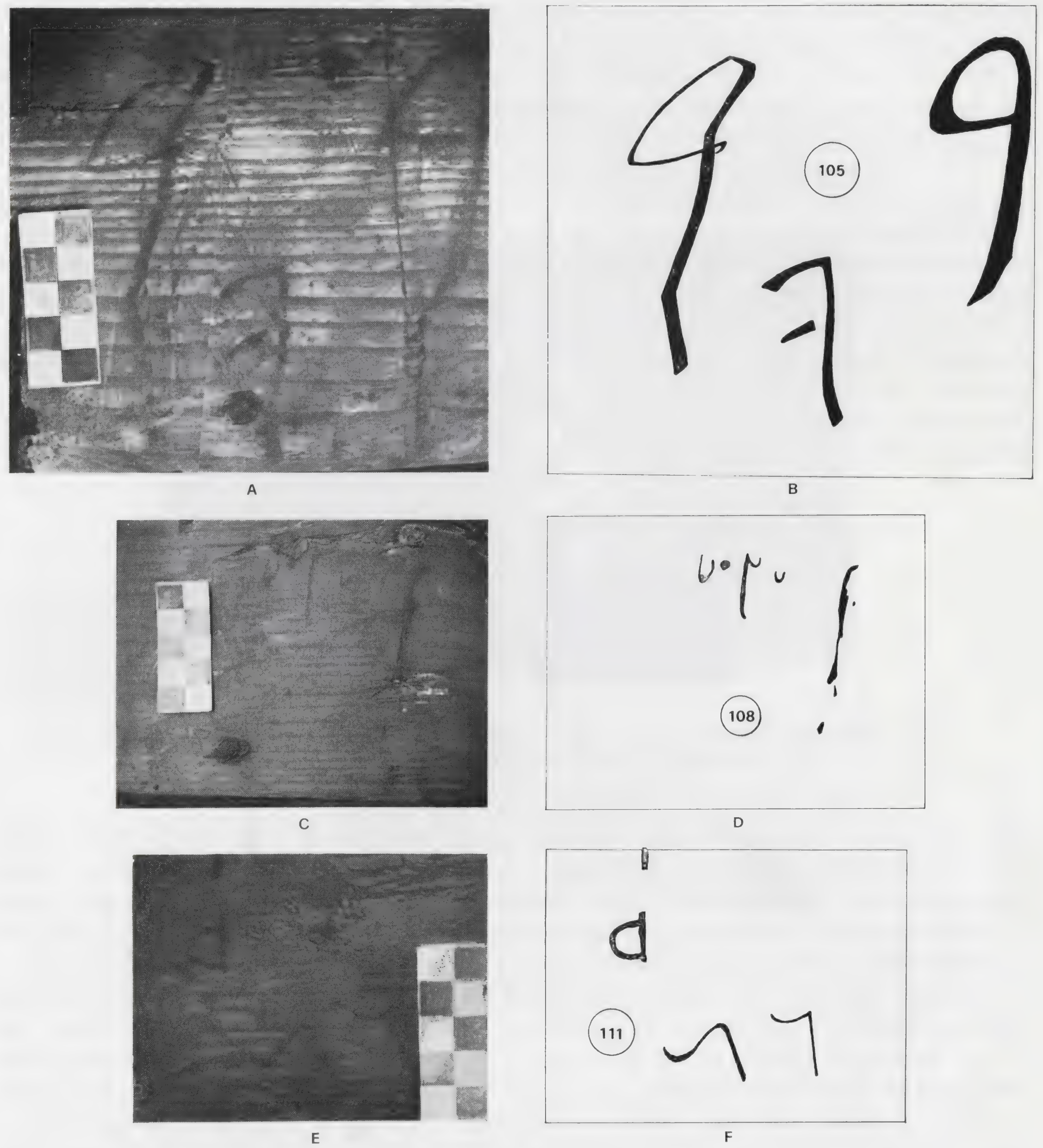
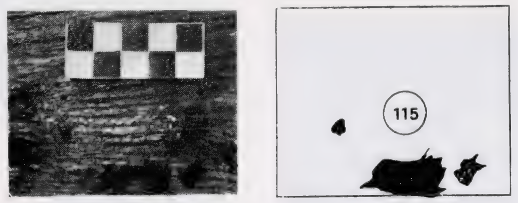


Fig. 142. - Interior of strake 3 starboard:
A-B sign (105) at the seating of floor-timber 9;
C-D splashes (108) at the seating of floor-timber 11;
E-F sign (111) at the seating of floor-timber 17 (all photographed on land).

Some of the other, and less certain, signs on the sides of the keel may thus conjecturally be identified as the letter of the Phoenicio-Punic alphabet appropriate to the place of the relative floor-timber/rib in the series. Thus the mark (4) (figs. 114 and 140) at the seating of floor-timber 7 may be, or include, a *zayin* (reduplicated with splashes?), (7) (fig. 115) at the seating of floor-timber 11 a *kap*, (8) (figs. 115 and 141) at the seating of floor-timber 13 a *mem*, and (13) (figs. 116 and 135) at the seating of floor-timber 21 could include somewhere among the splashes a *šin*. Signs (14) and (15) (fig. 117), occurring in any case

between the seatings of floor-timbers 23 and 25, and 25 and 27, respectively, are more likely to be the fragmentary remains of *bet* and *dalet* referring to ribs 24 and 26 than of *alep* and *gimel* referring to floor-timbers 23 and 25. If the hypothesis may be pursued still further, sign (9) (fig. 115) at the seating of floor-timber 15 should be *samek*, and (16) (fig. 118) at that of floortimber 31 *ṭet*, but of these letters there is hardly a vestige.

This explanation has not, however, dealt satisfactorily with signs (5) and (6) (figs. 115 and 133), nor with (10) and (11) (figs. 116 and 131): if these signs concerned the place of their related floor-timbers in the sequence of floor-timbers/ribs, then on the theory above the first two should be *ṭet*, the third a *pe*, and the fourth a *qop*. These are implausible readings. Sign (11) in fact suggests the necessary supplementary hypothesis. Floor-timber 19 is marked by two signs (11) and (12); it may be suggested that while (12) *qop* (fig. 132) marks the place of floor-timber 19 in the sequence of floor-timbers/ribs, (11) is simply the general mark for the siting of a floor-timber/rib. There does indeed seem to be a series of signs (*waw* in the Phoenicio-Punic alphabet) which are variations of this general sign for the siting of a floor-timber/rib: (5) and (6) (figs. 115 and 133) are the clearest on the keel, (106)



A B

Fig. 143. – Blots (115) on the interior of strake 4 starboard forward of the seating of floor-timber 19 (photographed on land).

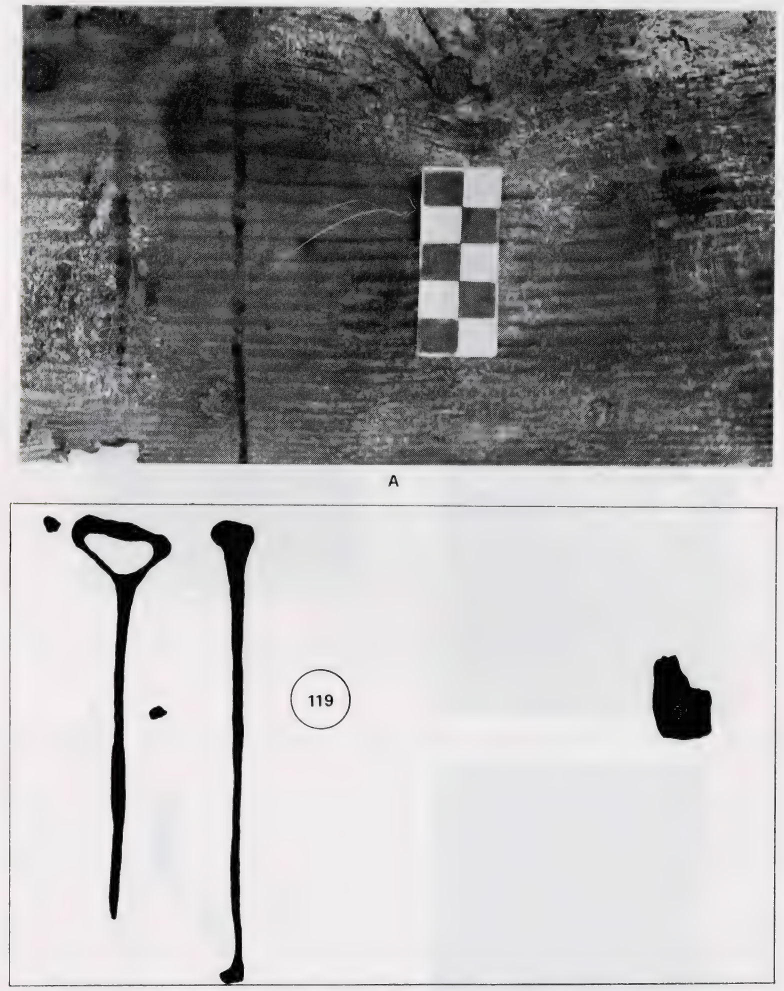
(figs. 115 and 112), (111) (figs. 116 and 142), and (A118) (fig. 147), on the sides of the ship. At first sight, this may appear to be an unlikely hypothesis. But in fact its correctness may be confirmed by the following observation. In signs (111) and (A118) the *waw* is actually reduplicated, a circumstance that demands explanation. It may be suggested that in these cases the two *waw* are no longer mere examples of the letter of the alphabet but together constitute the word *waw* from which the letter of the alphabet takes its name [7]. Now so far this word has not been attested in Phoenician, to the best of my knowledge (see, *e. g.*, C. F. JEAN, J. HOFTIJZER, *Dictionnaire des Inscriptions Sémitiques de l'Ouest*, Brill, Leiden, 1965), but it does occur in Hebrew and Aramaic where it means 'fastener, nail, peg, hook', or the like. Thus with a fair deal of confidence it may be claimed that signs (111) and (A118) are actually words meaning 'nail' or the like; in the case of the other *waws* in this group the first letter only of the word *waw* has been used but with the same purpose of indicating the place for the nailing of a floor-timber/rib in position [8]. It may be that some of the other signs on the sides of the keel,

(7) W. JOHNSTONE, *Biblical Hebrew* Wâwim *in the Light of New Phonician Evidence*, *The Palestine Exploration Quarterly*, Vol. 109, 1977, pp. 95 ff.

(8) Additional evidence for the use of the letter *waw* on the keel to indicate the place for the nailing of timbers in position above comes from the 'Sister ship'; see H. FROST, *Another Punic wreck in Sicily-its ram. 2. The ram from Marsala, IJNA* 4, 1975, pp. 219 ff. Here a *waw* has been found on the starboard 'tusk' of the ram, which is nailed to the keel, at the point where the stem-post rises from the keel; there is a double row of nails immediately above securing the garboard and strake 2 to the stem-post (fig. 150 in this chapter).

perhaps numbers (7), (8) (figs. 115 and 141), and (10) (figs. 116 and 131), are also fragments of the letter *waw* (the wood is cracked across sign (10) thus giving it the misleading appearance of being a *mem*).

Marks (17) and (18) (*samek* and *zayin*?) (figs. 116 and 118) would both stand outside these two systems, but, besides being dubious readings (are they splashes? The wood at (17) is very worn), are anomalous in being written on the top of the keel.



A B

Fig. 144. – Spills (119) on the interior of strake 3 starboard between the seatings of floor-timbers 19 and 21 (photographed on land).

The other signs at the seating of floor-timbers and ribs on the sides of the ship do not seem to concern the place in the order of sequence of these floor-timbers/ribs in the general series but to have a more particular reference. It is probably worth discussing only the most legible of these.

The force of the signs (94), (96) and (97) (figs. 119, 120 and 138) on the interior of strake 13 port at the S-shaped scarf is not clear. They seem much too large to be considered as forms of the letter *'ayin* in the Phoenicio-Punic alphabet. Since one of them actually straddles the scarf, it would appear that they concern more probably the nailing

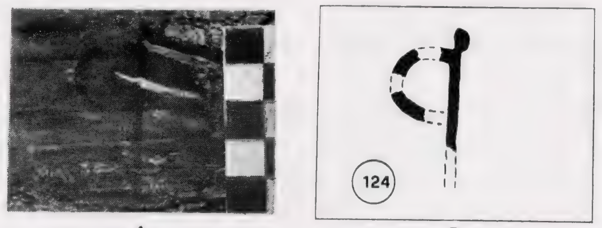


Fig. 145. – Sign (124) on the interior of the port garboard forward of the seating of floor-timber 23 (photographed on land).

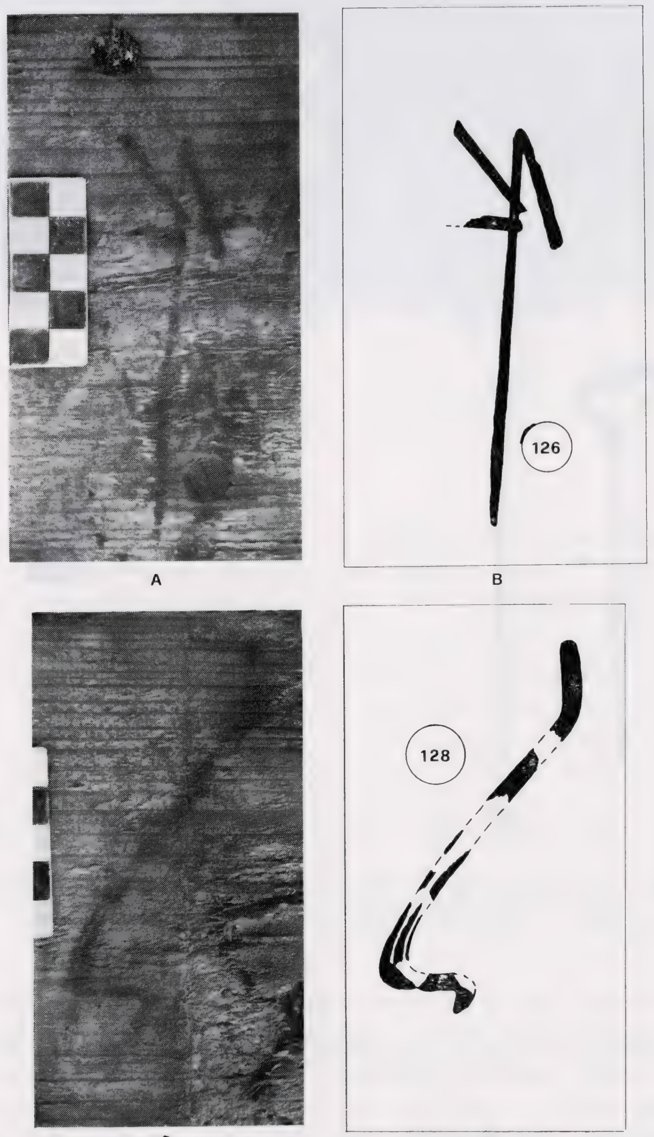


Fig. 146. – Interior of strake 11 port:

A-B sign (126) at the seating of floor-timber 33;
C-D sign (128) at the seating of rib 39; (photographed on land).

of the scarfed timbers to the ribs at suitable points than the fitting together of the scarfed timbers themselves.

The function of the incised 'X' (99) (figs. 119 and 138) is presumably related to its location: it stands directly above the after end of the keel scarf and lies between rib 18, the rib with the deepest plunge (to strake 5, while all the other ribs begin on strake 7, except rib 38, which begins on strake 6), and floor-timber 19, the floor-timber with the highest rise (to strake 13; floor-timbers 21 and 31 reach strake 12, floor-timbers 25, 29, 33, 37 and 39 reach strake 11, and the rest strake 10).

Signs (103) and (104) (figs. 122 and 139) seem to concern the fixing of their double S-scarfed timbers to a rib in a suitable position, in this case almost exactly in the middle

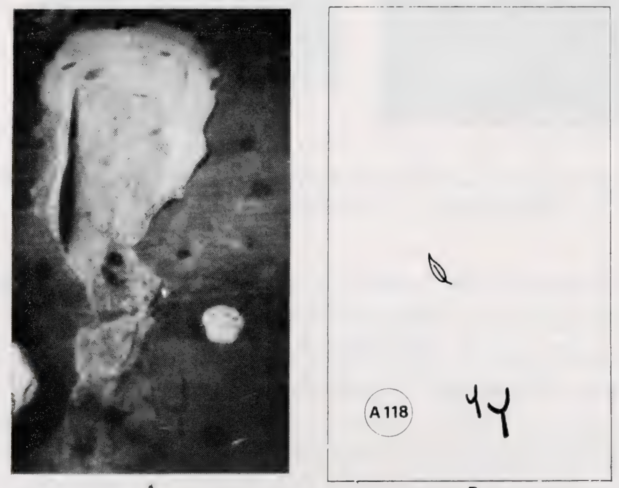


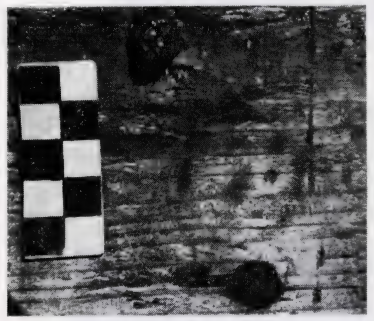
Fig. 147. – Sign (A118) on the interior of strake 8 port at the seating of rib 20 (photographed underwater).

of the timbers, rather than the fixing of these timbers to their common neighbour, strake 13.

Unfortunately, both of these signs are too faded or abraded to be certainly identified. If sign (103) is alphabetic, it might contain the *gimel* and the *'ayin* of the Phoenicio-Punic alphabet, the *'ayin* being the more certain of the two. If so, they have been written ' upside down ' like signs at other ribs, notably (A118). It is unlikely that they are together part of a word: the *'ayin*—if such it is—is written rather too far below and to the left of its companion letter. The *gimel* is, however, anomalous: its ' left leg ' is excessively long and ends with a short upward perpendicular stroke. In fact, therefore, it may like the squiggle (91) (figs. 110 and 116) be non-alphabetic, pictorially representing a constructional feature, in this case the double curve of the S-shaped scarf. If so, the ' right leg ' and the perpendicular at the bottom of the ' left leg ' which is parallel to it would represent the upper and lower edges of the strake, while the double curve of the ' left leg ' would portray the S-shape of the scarf itself. It is possible that the '*'ayin*' too is merely a primitive mark and not truly alphabetic. Like (94), (96), and (97), despite their disparity in size, it may merely denote the place where a nail is to be inserted. There is a vague trace of a continuation of the sign aft of (103) (a cross and a tick?) and of perhaps a similar sign (104) on strake 14 which also has opposing S-shaped scarfs.

Sign (110) (figs. 111 and 115) on the interior of strake 3 starboard at the seating of floor-timber 13 appears to be rather crudely written and is probably contaminated by the

wash from the nail which has been hammered though it. If, as it could be, it is read as a *mem*, it would fit into the postulated system of lettering the floor-timbers/ribs successively according to the sequence of the Phoenicio-Punic alphabet. In this case it would match sign (8) (figs. 115 and 141) on the starboard face of the keel. It must, however, be




A B

Fig. 148. – The possible *tet* on the interior of strake 11 port at the seating of floor-timber 31 (photographed on land).

admitted that sign (110) could equally easily be read as *bet*, *waw*, or *kap*. The vertical paint marks on either side of it are probably merely splashes.

Sign (105) (figs. 110 and 142) on the interior of strake 2 starboard at the seating of floortimber 9 is particularly intriguing. Again there appears to be here a complete word, the consonants of which are probably to be read *bet*, *he* and *reš*. Once more the word has not been attested hitherto in Phoenician. The root in Hebrew, Aramaic, and Arabic has the connotation of 'bright, clear'. It may be apposite to cite developed technical senses

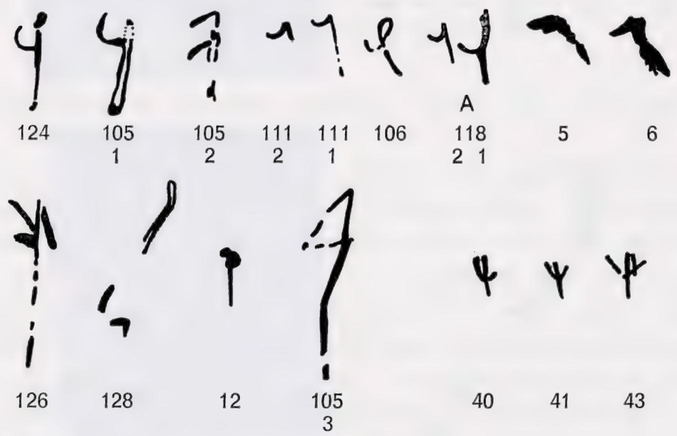
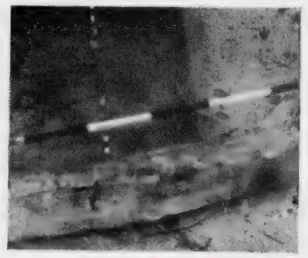
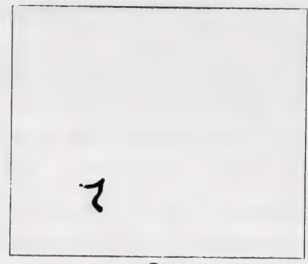


Fig. 149. – The most certain letters of the Phoenicio-Punic alphabet occurring among the shipwrights' marks.

of the root in Arabic. *'abhar* is used to describe part of the limbs of a bow. The eighth-ninth century A. D. philologist al-Asma'i (quoted in Ibn Manzur, *Lisan al-'arab* [ed. Dar Ṣadir, Beirut, 1955], Vol. 4, p. 83) describes the constituent parts of the body of the bow symmetrically about its centre; the extremity (*si'ah*), to which the bow-string is attached, is followed by a curved part (the *ṭa'if*); between this curved part and the *kulyah*, which adjoins the centre, lies the *'abhar*. Further precision is given by the treatise *Arab Archery* (ed. N. A. Faris and R. P. Elmer [Princeton, 1945]), which, though written by a

Moroccan about 1500, relies on classical sources. This work (especially pp. 13, 15, and the appendix pp. 160 ff.) makes it clear that this terminology applies only to the composite bow with its concave-convex profile. The body of the composite bow is made up of five independent sections jointed to each other by single fish splices—the handle (*miqbaḍ*), to each side of which is attached an arm (*bayt*), to each of which in turn is spliced a recurved end (*si'ah*).

A B

Fig. 150. – The starboard 'tusk' of the ram of the 'Sister ship' with the letter *waw* painted below the double line of nails securing the garboard and strake 2 to the stem-post (photographed underwater).

Looking at a strung bow from the point of view of the archer, the *'abhar* (' spine ') is the concave part of the arm immediately above its splice (*?daffah*, ' hinge ') with the handle, while the *ṭa'if* (' neck ') is the succeeding convex part of the arm extending up to the splice (*rukbah*, ' knee ') with the *si'ah*. The *kulyah* (' kidney ') seems to be a transverse binding of sinew at the joint of handle and arm.

It is accordingly suggested that the not-dissimilar profiles of bow and keel were described, at least in part, by analogous terms (it may be noted that *bahirah*, another word from the same Arabic root, means 'ship'; cf. R. Blachère, M. Chouémi, C. Denizeau, *Dictionnaire Arabe-Français-Anglais* [Maisonneuve, Paris 1967 et seqq.], p. 870). If so, then *bhr* refers to that part of the keel aft (and fore?) of the central section which bends up in a concave curve into the stern. At all events, it is precisely opposite the beginning of the upward rise of the keel towards the stern that the word *bhr* is written on the interior of strake 3 starboard.

Its being written 'upside down' strengthens the probability that that strake was being fitted 'from above' vis-à-vis a point on the keel [9].

§ 3. *Comparative material.*

It remains to make some remarks of a palaeographical nature concerning the alphabetic signs. In this task, it seems best to make use of a standard classification so that the correspondences of the signs on the ship to already known epigraphical material, and their divergencies from it, may be the more readily displayed. Fundamental to the discussion here therefore is the work of J. B. PECKHAM, *The Development of the Late Phoenician Scripts* (Harvard U. P., 1968) to which frequent reference will be made in what follows [10].

(9) Further discussion of *bhr* will be found in W. JOHNSTONE, *The epigraphy of the Marsala Punic ship: new Phoenecian letter-forms and words*, in *Atti del I° Congresso Internazionale di Studi Fenici e Punici* (Centro di Studio per la Civiltà fenicia e punica, Rome) (forthcoming).

(10) Also useful in Tableau 2 " Principales formes des lettres en cursive phénicienne " in A. VANEL, *Six ostraca phéniciens trouvés au temple d'Echmoun, pres de Saïda*, in *BMB* 20, 1967, pp. 45 ff.

In § 2 it has been seen that perhaps as many as seventeen of the twenty-two letters of the Phoenicio-Punic alphabet are still traceable in whole or in part, with greater or lesser degree of certainty, on the ship (viz., *bet*, *gimel*, *dalet*, *he*, *waw*, *zayin*, *ṭet*, *kap*, *lamed*, *mem*, *samek*, *'ayin*, *pe*, *qop*, *reš*, *šin*, and *taw*). Many of these are, unfortunately, too fragmentary or dubious for the purposes of comparison: there are, however, some seven letters whose occurrence is virtually certain and which have been preserved sufficiently completely for the purposes of comparison, namely, *bet* (two examples, 105 (i) and 124), *he* (105 (ii)), *waw* (seven examples 5, 6, 106, 111 (i) and (ii) and A118 (i) and (ii)), *kap* (126), *lamed* (128) *qop* (12), and *reš* (105 (iii)) (see fig. 149).

bet (105 (i), 124). The loop at the apex of (124) indicates that the head of this example was drawn clockwise from the bottom right, the movement then continuing anticlockwise though the loop and thence down the shaft. It is likely that (105 (i)) was also written clockwise from the bottom right of the head (cf. the *reš* in the same sign discussed below); the apparent openness of its head is simply due to the accidents to which the letter has been subject in its preservation. In both cases the shaft is long, inclining slightly to the right with virtually no turning to the left at the bottom to make a horizontal foot.

The drawing of the head clockwise from the lower line is a mark of the cursive tradition (PECKHAM, *op. cit.*, p. 26); the lack of distinction between shaft and foot is to be observed in formal *bet* under cursive influence from the early fourth through the third centuries B.C. (until the second century at Tyre (*ibid.*, p. 89)); the vertical stance, again influenced by cursive writing, is to be found in the same period (*ibid.*, pp. 26, and 135); similar phenomena are to be found in the Punic script (cf. forms from the fourth and third centuries B.C. in PECKHAM, *op. cit.*, Plates XII and XIII).

he (105 (ii)). The top (if the upper extant stroke was the top) and the shaft were perhaps drawn in a single stroke from left to right and then down; the shaft is vertical, leaning slightly to the right and then left; the middle line is roughly equal in length to the top and parallel to it but it is not wholly clear whether it is attached to the shaft or not; no lower line is visible, though perhaps there is a shadow indicating a sharper inclination down to the left.

This letter, in the formal style, seems to be highly conservative; from the seventh to the third century in Cyprus, for example, there is progressive rotation of *he* to the left and the lines are detaching from the shaft by the fourth century (PECKHAM, *op. cit.*, p. 28), though even there upright examples with attached lines are still to be found in the mid third century (*ibid.*, Plate III.3). Tyre preserves a more formal, conservative tradition as late as the first century, though there the shaft remains short (*ibid.*, p. 139); a conservative formal tradition is also to be found at Carthage (*ibid.*, p. 202).

waw (5, 6, 106, 111 (i) and (ii), and A118 (i) and (ii)). The seven examples are clearly all cursive, drawn in one stroke from the left side of the head; in all cases the letter inclines to the left and the head is an arc drawn to the top of the shaft, in two cases going somewhat beyond it; there is considerable variation in the depth of the arc, (5) being the shallowest, (A118(i)) the deepest; there is also variation in the mode of connection between the head and the shaft —flowing of arc into the shaft (5), standing of shaft at the right edge of the arc (111(i) and (ii), A118(ii)), doubling back along the right side of the arc and turning down stem (6, A118(i)); in (106) the crescent is joined to the shaft at its right edge by a loop turning anticlockwise up, over and down (cf. the top loop on *bet* (124)). (Idiosyncratic is the 'sway-backed' shaft of *waw* in sign (10) [fig. 131]; it is of uncertain reading, but the occurrence of a related one in the 'Sister Ship' [fig. 150] tends to confirm it.)

The diagnostic feature here is the head in the shape of an arc drawn to or beyond the top of the shaft; under the influence of a cursive convention already attested in the fifth century, the square head of the formal *waw* becomes crescent-shaped and is written to the top of the shaft in Cyprus and Tyre by the beginning of the third century (PECKHAM, *op. cit.*, p. 142, and Plate VI. 6); at Carthage, the head, though still squared, has moved to the top of the shaft by the end of third century, indeed goes beyond it in the late third century and commonly in the second (*ibid.*, p. 203).

kap (126). Idiosyncratic is the up stroke at the top right side of the shaft preparatory to the downward stroke. The stance is vertical with slight inclination to the right; the shaft is straight with a slight bend to the left. The head is of the very traditional three-pronged variety.

This letter is formal and highly conservative in style—it could easily belong to the sixth century or earlier (PECKHAM, *op. cit.*, Plates VII and VIII). Peckham lists nothing similar for a later period from Cyprus, Byblos, or Carthage; there is, however, an analogous form found at Umm al-'amed, in the vicinity of Tyre (which has perhaps antecedents at Sidon where in the fifth century the head may be in the form of a wedge drawn in three strokes (*ibid.*, p. 152)), from between the end of the fourth century and the last quarter of the third century B.C. (*ibid.*, Plate VI, 4 and 5).

lamed (128). It may be presumed that it was drawn in a single stroke from the top; the shaft is long, beginning vertically and then curving down from right to left; the foot is horizontal and terminates in a short dropline on the right.

The diagnostic feature here is the dropline: it occurs in Cyprus from the earliest fifth century lengthening only in the latest period (PECKHAM, *op. cit.*, pp. 33 f., 155) and at Byblos from the fifth to the second century (*ibid.*, p. 59). At Tyre the shaft lengthens in the fourth century, while the foot and dropline remain short; the dropline lengthens from the end of the third century (*ibid.*, pp. 95 f.). At Carthage the squared foot becomes rare in the second century—the drawing of the foot and dropline in a single curved stroke beginning to appear from the last half of the third century (*ibid.*, pp. 210 f.) (*i.e.*, in a period later than that to which sign (128) must then belong).

qop (12). The left head was drawn clockwise from the lower right round into the shaft; the shaft is long vertical; the small, rounded right head was drawn independently clockwise (there is a starting blob at the top roughly in line with the lower side of the left head and a finishing one on the shaft), with the consequence that the head gives a slight suggestion of being open—an idiosyncratic feature.

The letter is in the formal tradition, but is heavily influenced by the cursive manner (see the remarks of PECKHAM, *op. cit.*, pp. 169 and 216); the independent right head high on the shaft is found in the fourth to third century lapidary style in Cyprus (cf. *ibid.*, Plate III.4.). At Tyre the stance is vertical from the fifth century onwards, but the lower line of the right head does not meet the shaft from the third century (*ibid.*, p. 99). Punic is also in the cursive style, but before the end of the third century the left head is lost (*ibid.*, p. 217). The indications then are that sign (12) is to be dated to a period from the fourth to the first part of the third century.

reš (105 (iii)). The head appears to have been written clockwise from the bottom right (there is a starting blob on the shaft at that point) round into the shaft; the head is triangular, slightly sway-backed; the shaft in idiosyncratic: vertical in stance, it is even more pronouncedly sway-backed being inclined first to the right and then to the left

(cf. the idiosyncratic sway-backed shaft of the *waw* in sign (10) and on the ram of the 'Sister ship').

Peckham signalises the sway-backed shaft only in the letter *bet*: he regards it as a peculiarity of Punic, appearing in the first half of the third century as a development from the script of the Cypriot tariffs of the second half of the fifth century (PECKHAM, *op. cit.*, pp. 26, 199 f.). The triangular head in *reš* is still found in the fifth to fourth century in Cyprus: he attributes it to the influence of the cursive style on the formal (*ibid.*, p. 138). The vertical stance is similarly due to the influence of the cursive style, occurring already at the beginning of the fourth century in Cyprus (*ibid.*, p. 139).

The palaeographical evidence looked at as a whole would yield a date between 300 and 250 B. C. for the construction of the ship. While the *he* and *kap* are not specific and the *bet* could fall within the fourth or third century, *waw* and *reš* would not appear to be earlier than 300 B. C. and *lamed* and *qop* not later than the mid third century.

The place of origin of the ship (or of the craftsmen involved?) is less easy to deduce. The forms of these seven letters do not correspond coherently as a group to their counterparts in any one inscription known to me. Thus, *e.g.*, while the form of *kap* is similar to that found in the Ba'alyaton stela at Umm al-'amed (dated in any case by the excavators to the third quarter of the second century B. C.), none of the other four letters common to the ship and to that stela (*bet*, *he*, *lamed*, and *reš*) corresponds in form to another (cf. M. DUNAND, R. DURU, *Oumm el 'Amed* [Maisonneuve, Paris, 1962], Vol. 1, p. 188).

The most idiosyncratic letter on the timbers of the ship is undoubtedly the *reš* (105 (iii)). Since the sway-backed shaft—at all events in *bet*—has been signalised as a peculiarity of Punic, the occurrence of this feature may point to a central or western Mediterranean place of origin. Again parallels to the forms of individual letters may be found within this region, but there is no one text which has been recovered which contains within itself forms exactly corresponding to those of all the letters on the ship taken as a group. Inscription 15 at Antas in Sardinia, dated fourth to third century, contains both *bet* and *reš* with rounded head written clockwise; the head of the *bet* has a peak and the shaft of the *reš* is slightly swaybacked; the *kap* is, however, quite different (see M. FANTAR, "Les inscriptions" in *Ricerche Puniche ad Antas* [Studi Semitici 30, Rome, 1969], p. 85). Perhaps most significant is the fact that sway-backed *reš* is now evidenced from Sicily itself. A number of examples are to be found among the inscriptions of the Grotta Regina just west of Palermo (see especially Inscriptions I, line 3, II, line 3, VII, and VIII, line 2 in M. G. GUZZO AMADASI, "II. Le iscrizioni" in *Grotta Regina* I [Studi Semitici 33, Rome, 1969], pp. 42 ff. and figs. 12 ff.). None of these inscriptions is dated by Guzzo Amadasi earlier than the fourth century B. C. The *bet* and *qop* are, however, different from those found on the ship [11]. B. Rocco (whose dating of the Grotta Regina inscriptions tends to be higher than Guzzo Amadasi's) signalises two Punic inscriptions on a vase which perhaps originates from Marsala. One of these contains a *reš* with triangular head and sway-backed shaft (a form which, however, Rocco thinks has been adopted to avoid overlapping with the adjoining letter). Once again, however, the form of *bet* (open head written anticlockwise with top loop) is different from that found on the timbers of the ship (see B. ROCCO, Vaso punico da Marsala (?) con iscrizioni fenicie, in *Sicilia Archeologica* 26, Settembre-Dicembre 1974, pp. 31 ff. I am indebted to Miss Frost for access to this article). The inscriptions, like

(11) For the *kap* of the three-pronged variety in the Grotta Regina inscriptions, see the first four examples in Table 3 in B. ROCCO, *La Grotta Regina: osservazioni paleografiche e nuove traduzioni*, in *AION*, N. S. 21, 1971, p. 3.

the vase on which they are painted, are dated to the fourth or to the very beginning of the third century.

There remains *the 'bird's-foot' sign (40, 41, 43 and A43)* on which to comment. In view of the coherent series of signs derived from the Phoenicio-Punic alphabet used on the ship, it would be implausible to seek for the origin of this sign in some other alphabet, unless it is a traditional carpenters' mark with remote alphabetic antecedents. In fact, a more satisfactory identification of the sign may lie to hand. It may be suggested that it represents a yet further development of the writing of the letter *waw* (the inclination to the left of (40) and (41) is to be noted) of which sign (106) provides the intermediate form. The suggestion is strengthened if the observation in § 2.5 above is correct that the sign, or the more certain examples of it, points to the location of a nail (*waw* in Phoenician, as is argued in § 2. 11) [12].

WILLIAM JOHNSTONE

(12) For the significance for the history of the Greek alphabet of the attestation of this form of cursive Phoenician *waw* see W. JOHNSTONE, *Cursive Phoenician and the archaic Greek alphabet*, in *Kadmos*, 17, 1978, pp. 151-166.

SUMMARY. — Correctly interpreted, the shipwrights' marks ought to provide evidence concerning the method of construction, the date, and the place of origin of the ship.

In the foregoing attempt to evaluate the marks, it has been argued that the method of construction of the ship was as follows: the keel was laid down first; the starboard garboard was attached before the port garboard; strakes 2 and 3 on both sides were probably attached independently; there is no evidence one way or the other whether strakes 4-11 port were attached independently or, at least in part, as a prefabricated unit; when strake 11 port had been reached, the floor-timbers were inserted; strakes 12-14 port were then added as a prefabricated unit; after an unknown number of strakes had been added above strake 11 port, the ribs were inserted.

Of the two hundred or so marks, some thirty or forty are derived from the Phoenicio-Punic alphabet. The palaeography of these letters indicates a date between 300 and 250 B. C. As for the place of origin in the Phoenicio-Punic world, the balance of probability points to the central Mediterranean, Sicily itself being a strong candidate. Two new words *bhr* ('keel') and *ww* ('nail') have incidentally been added to the known Phoenician lexical stock.

XIII. CONSTRUCTION

The Planking

The trunk of a tall conifer can be visualized as an extremely elongated cone which, if sawn through, can produce boards just over 3 cm thick and varying in width. The widest board comes from the centre of the trunk, those out to either side of it become progressively narrower. The point of the tree will have been severed so that these boards will be trapezoidal, but so elongated that to the naked eye they will appear almost parallel sided.

Such was the planking used in the Punic Ship (see detail, fig. 138); the wider and narrower boards resulting from the through cutting, were alternated up the sides of its hull. The only additional working they received was along their edges, because planks used in the curved portions of the hull had to be acutely angled in section, whereas those used in the straight parts of its sides could be virtually right-angled in section.

M. Paul Adam has pointed out that one of the main differences between modern (i.e. post-Renaissance) and Classical ships' strakes is that the former are an extremely elongated egg-shape and the latter, as we have seen, are equally elongated trapezoids. It follows that the " modern " builder's task was more complex, falling into two stages: 1, the cutting of a plank, 2, the shaping of it into a strake, when it had not only to be given a curve, but this curve had to be worked out in relation to the neighbouring strakes. The ancient method, whereby the planks were used as cut, was therefore very much quicker; a point that must be borne in mind when considering Polybius' (i, 20) reference to the incredible speed with which the Romans produced replicas of a Punic Ship.

Relation of Planking to Hull Shape; Stern

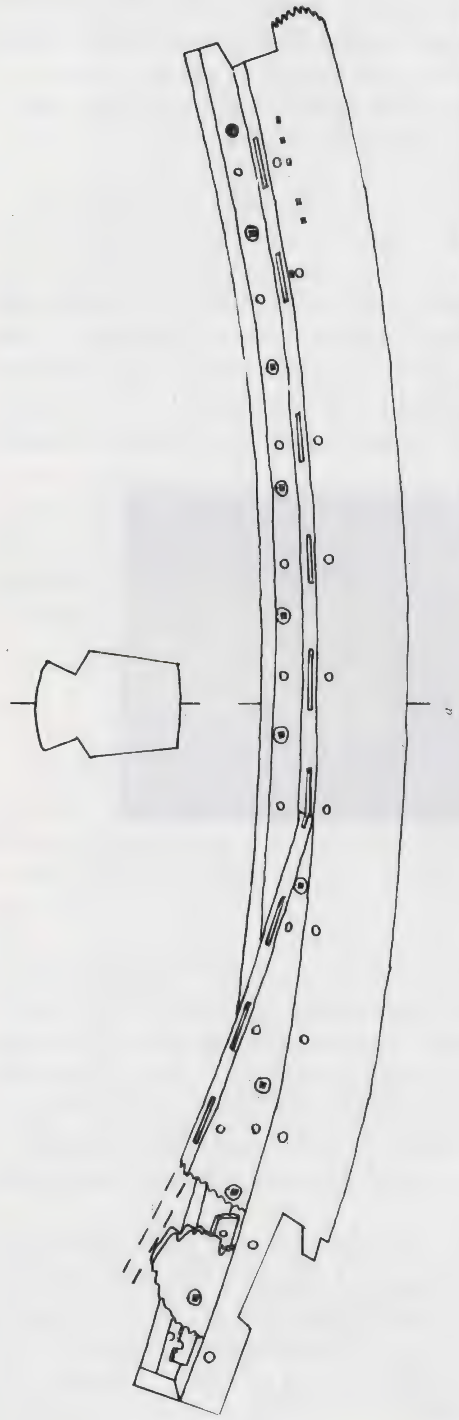
These differences in planking affect the shape of a hull. The ancient " trapezoidal " planks had wider butt ends than the modern " egg-shaped " variety, hence the spoon-shaped " swan's necked " stern of Classical ships and their vertical stemposts which, when a ram was present as on the Sister Ship could not have been curved. Conversely, sterns could not have ended in vertical posts because this would make any ship, whether driven by oar or sail, almost impossible to steer.

It had been Paul Adam who pointed out that because the planks were straight and parallel sided they could only be brought into a spoon-shaped upcurving stern, thus providing the three dimensional explanation for the familiar "swan's necked" silhouette seen on almost all ancient representations of ships. Austin Farrar had made the same discovery independently, while he was working on his trial model. Unlike Adam, he happened to be in possession of reduced copies of the complete set of wood-drawings, which included some from other sites in the area. One of these was a curved timber that had been found by Diego Boninni in 1969, shortly after my first visit to Marsala (fig. 152). He had uncovered it while dredging for sand near another wreck, about one kilometre to the

a

b

Fig. 151. – *a*) Stern of the Punic Ship; *b*) Prow of the Sister Ship.



a

b

Fig. 152. – *a*) Upper part of a sternpost lifted by Diego Bonnini of the Sand-Dredger in 1969-70 (1 : 10); *b*) Detail of the scarph from " Boninni's " sternpost.

south of the still unknown site of the Punic Ship. He raised the timber and presented it to me in 1970. I duly drew it with the help of Robert Knox and then forgot about it. This drawing eventually got reduced with all the rest and was noticed by Farrar while he was puzzling over the problem of the stern. Not realizing its history, but seeing that it was the upper part of a sternpost and that it fitted onto the rise of the Punic Ship's keel, he used it there and found that the planking immediately fell into place on its curve.

I do not think that Boninni's sternpost could have belonged to the Punic Ship, but it must have belonged to another very similar ship.

The Garboards

A small number of the Punic Ship's planks were not through-cut: for instance the garboards and second strakes immediately above them. Both sets were "sculpted", i. e. they were not parallel sided in section, having been shaped with an adze so as to produce the basic curvature of the hull from its narrow extremities to its gradual flattening out amidships (fig. 153). This shaping of the garboards avoided having to change the angles

Fig. 153. – Detail of the starboard garboard showing the "sculpted" adze-marks and the putty on which the base of floor-timber no. 23 had rested (compare fig. 36).

of both the keel rabbets and the angles of the tenons that would hold the garboards in place there. The alternative form of construction, using sawn, through-cut garboards, meant modifying the angles of both rabbets and tenons thoughout the length of the keel, and applying torsion to the garboards as well; the result would have been less solid. Structurally, the greater thickness of the "sculpted" garboards is one of the many, to us, surprising contrivances used in classical shipbuilding to add longitudinal strength to the keel-structure. In a long, light, oared ship this would be very necessary, especially if its prow had been fitted with a ram (1).

We know from Dr. Johnstone's study of the signs, that the starboard garboard was the first strake to be set up, after the central pinewood section of the keel had been laid and joined to its aftermost maple wood portion (which embodied the rise of the keel or stern post). Sculpted strake No. 2 to starboard was the next to be positioned. Thereafter the sawn planking may have been assembled in sections before being erected. Though there is no positive proof of this until strake No. 11 is reached, it is suggested by a change in

(1) For the alternative construction with parallel sided garboards see J.-P. Joncheray, *L'Epave "C" de la Chrétienne*, Nice 1976, p. 45.

joinery after the garboards. The ends of both the sculpted strakes are united to the rise of the keel in exactly the same way as their main straight edges are joined: by tenons and widely spaced nails. The butt end of the next strake up, No. 3, is however, joined to the sternpost by closely spaced, double rows of nails, between which are still visible the lines that had been painted as guides to their insertion.

Strakes Assembled in Sections Before Erection

Again, it was William Johnstone who noticed rings of paint (from the dirty base of its pot) imprinted inside the hull (fig. 138). These rings spanned seams, they therefore prove that the strakes in question must have been assembled on the flat, because had they already been erected on the side of the ship, no pot could have been set down on top of them. The rings occur on strakes No. 11 and 12, but for several reasons they are unlikely to have been the only planks to have been assembled before erection. As Johnstone points out, it would have been extremely difficult to unite the S-shaped scarphs, had the strakes not been lying flat. Further, the fact that the painted ticks indicating the spacing of the mortises, only occur along the edges of some planks, suggests that those were the planks that had been prepared for assembly from above. Finally, the change in joinery between the garboards and the strakes above them, further strengthens the view that the sides of the ship were not built up strake by strake, but by pre-assembled sections of strakes.

The Scarphing of the Strakes

Strake 11 mentioned above, bears not only rings of paint, but more painted signs than any other part of the hull except the keel. Structurally, this strake, is of key importance for two reasons: first, it comes directly below the waterline which, exceptionally, is indicated on this hull by a series of spray deflectors (discussed below). Second, it is the only strake crossed by every rib, by the top ends of the floor timbers and the bottom ends of the frames, which accounts for the number of alphabetic signs it bears (the ribs being arranged in a lettered sequence forwards from the stern).

Strake 11 is also one of the longest and, with the single exception of strake 9, it is the only one not to have been scarphed. The scarphing on the port and starboard sides appears, incidentally, to be a mirror image, to judge from the surviving starboard portion and by analogy with other ancient wrecks of similar basic construction. What is surprising, is the amount of scarphing that occurs so near to the stern. In modern practice, scarphing is kept to the central portion of a hull for reasons of strength, but the reverse was probably true on classical hulls. When planks were joined by tenons and dowels, the joins were the strongest part of the planks. As with some of the new plastic adhesives, if a repaired object is re-broken, the new break will seldom coincide with a join. Certainly when dismembering the Punic ship and searching for points of weakness where the wood could be broken, these were seldom found at the seams (in fact, seams frequently did have to be taken apart, but this was done for aesthetic reasons, in view of the eventual reconstruction, not because it was easy).

It is therefore likely that the amount of scarphing near the stern was intended to give extra strength, as well as being a means of coaxing un-bent planking into the curve of the hull. There is some doubt as to whether steam or torsion was applied to ship's planking

Fig. 154. – Imprint of spray deflectors in lead (*photo J. Blair – N.G.S.*).

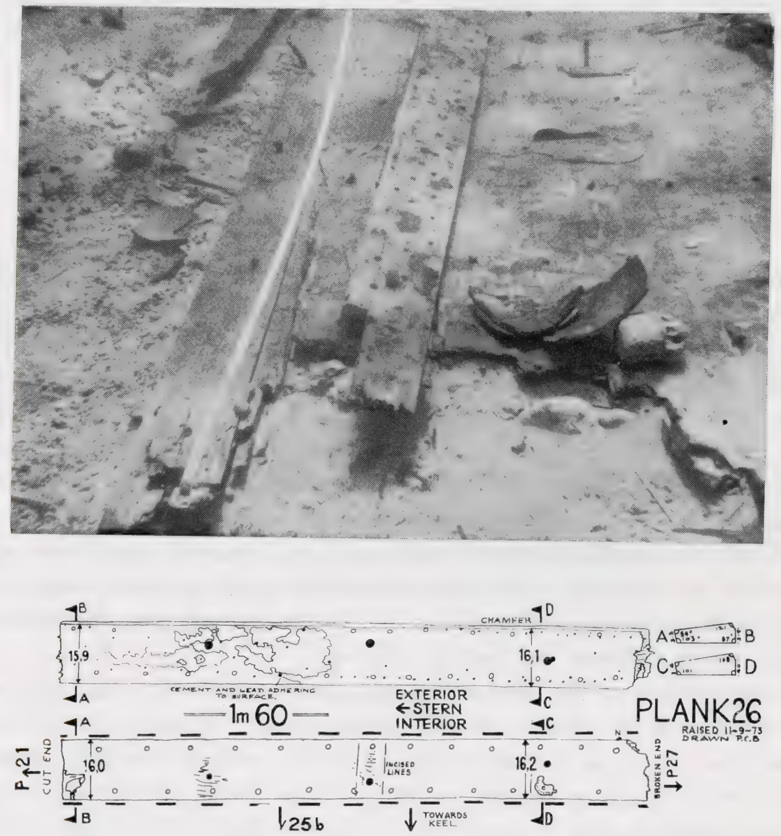
in antiquity. A reference by Theophrastos (2) implies that green wood was chosen by ship-builders because of its pliability. However this may be, the evidence of the Punic ship points to scarphing having been used to achieve the curve of the hull. There are two kinds of scarph: rectilinear oblique joins below the waterline, and s-shaped joins above it. The S-scarphs which are more closely spaced then the rectilinear, also coincide with the spray deflectors, i.e. a series of planks which, because of their external bevelling would have been extremely difficult to bend into a curve.

(2) THEOPHRASTOS, *Historia Plantarum* V, 7, 4.

The Spray Deflectors

This feature, which is of great interest, has not been found on any other ancient wreck. The external bevelling is designed keep the deck dry by deflecting the spray; this device is still used on fast sailing ships. Its presence on this hull further supports the view that the vessel was a warship. Four of the spray deflectors survive: on strakes 12, 13, 14, and on a fragment of 15. Unfortunately the main length of strakes 15, 16 and 17, which had been traced onto sheets of polythene, underwater, in 1972 (see fig. 113) had disappeared by 1973, when the bulk of the port planking was raised. As they were found under the

a



b

Fig. 155. – *a*) It came as a surprise to find an external bevelling on certain strakes such as this P. 13 (which has been laid face downwards prior to lifting). Note the patterning of the tacks that had attached the lead sheathing to the strake, also the putty inside the hull on the seatings of two frames. The pottery in the foreground had been found under the hull; *b*) Sections A-B and C-D show the external bevel of a spray deflector (from a 1 : 1 registration drawing by Peter Brachi, here reduced to 1 : 20).

port ballast stones, we replaced the stones on top of them at the end of the season, but stones being easy to remove by hand, I can only assume that the planks had been taken away after our departure by the same vandals who, earlier in the season had overturned our grids, torn up the base-line and stolen part of an amphora. In consequence we do not know whether the two missing planks bore spray deflectors on the outside. It is likely that they did, because the spray deflectors probably continued up to the first wale. Two lengths of wale were found on the site; they are discussed below.

The depth of hull covered by spray deflectors must be estimated on the basis of strakes 12–14 which measure 17 cm. across (at Rib 38); judging from the tracings, strake 15–17 would have been in the same order. Assuming that the two strakes which entirely disappeared had also borne spray deflectors, and that the first wale had indeed come directly above them, the system of spray deflectors would have constituted a belt over one metre wide, encircling the hull, and, incidentally, reinforcing its longitudinal strength. This width accords with the function at the waterline of any spray deflector (fig. 154).

The way that the external bevelling was achieved on this ship provides a second instance of "sculpted" planking. The hull being carvel built and its strakes joined edge to edge by tenons kept in place by dowels, it came as a very great surprise to us, on raising strakes 12–15, to find that there was shaping on the outside of this intrinsically smooth skinned hull. The overall bevelling was achieved by cutting the exterior of each plank so that it flared out towards its lower edge where it was then chamfered just above the seam, (fig. 155).

Planking and Signs: Clues to Size of Ship

Given planks and ribs of known shape and size it is theoretically possible to deduce the shape of the hull they would build, especially (in the case of a wreck) if remains of at least one of its extremities has survived. But it is easier to state a theorum than to work it out. With this ship, the problem is being approached by three experts from three different points of view. Mr. Austin Farrar FRINA, a naval architect, is building a trial model at the scale of 1 : 5; M. Paul Adam, an expert on ancient ships, is working out mathematically the possibilities inherent in the measurements of the wood that we recorded, and Mr. Frank Howard, author of several notable ship models, is building the definitive model of the Punic Ship. Until the implications of every nail and scarph have been agreed by this distinguished team, and until the actual wood of the ship has been conserved and reconstructed, I can do no more than to set down the basic reasons that have already led to its size being estimated at between 30 and 35 metres (3).

The surviving portion of the ship represents about one third of its total length, because where the hull breaks off the strakes are still widening out. Hitherto, for the sake of clarity, I have described the planks as "trapezoidal", but this was an over-simplification. I must now ask the reader to visualize a qualification. In one sense, the trunk of a conifer can be described as an elongated cone, but in fact the lower part of the trunk will be more like a pillar of constant diameter.

Turning to the hull itself, the greater length of its planking tapers towards both extremities, but this cannot mean that the hull is made up of perfect trapezoids, joined amidships by one of the shorter sides and to the keel by one of the longer. If this were so the hull would not be hydrodynamic; it would have an awkward angle amidships. What in fact happens is that the planks are trapezoidal only at the extremities; in the centre of the hull there is a portion several metres long, made up of parallel sided planks.

Since all the Punic Ship's surviving planks are still increasing in width at the break, the break cannot represent the centre of the ship. At least 4 m. of parallel sided planking would have to be interpolated before the surviving planks could take on the shape

(3) The hull was reconstructed in 1978, after this report went to press; see note to preface.

imated on the basis of strakes om the tracings, strake 15–17 strakes which entirely disap- ale had indeed come directly tituted a belt over one metre itudinal strength. This width tor (fig. 154).

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OF SHIP

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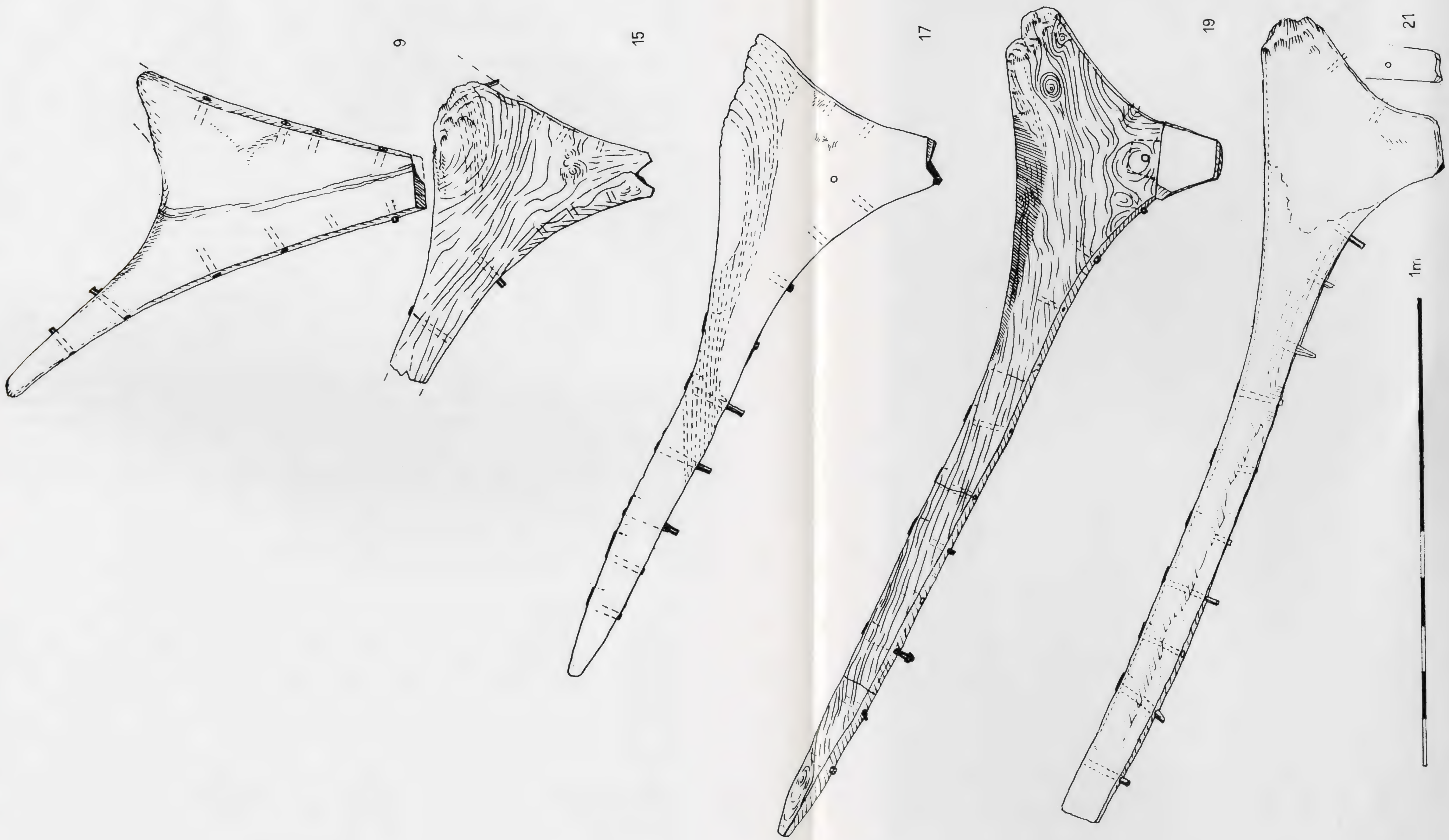


Fig. 156. – A sequence of floor timbers from the stern; note the inconsistency of the notching at their base, also the extension added to no. 19 in order to make inadequately sized wood fit the pre-determined pattern.

of a hull. Further, the length of a ship is estimated at deck level so that, if the surviving portions of this hull are projected upwards they would represent a measure of some 15 m. If we now add to this a hypothetical section of some 4 m of parallel sided planking, and then another 15 m. representing the fore part of the ship, it is evident that the total length of the vessel must have been greater than 30 m. This is one of the bases on which a more accurate estimate is being worked out.

An interesting cross check for the length can be based on Dr. Johnstone's hypothesis that the ribs were positioned in accordance with a lettered, alphabetic sequence, see Fig. 138 which he worked out from the surviving letters. The 22 letters of the Phoenicio-Punic alphabet have been used twice in the surviving part of the hull, implying that 6 additional timbers must have existed in the missing part of the stern, and forwards one frame and one floor timber are needed to complete the second alphabet. It is logical to suppose that the third time the alphabet was used would have been in the central section where the planks were parallel sided. Assuming that the spacing of the ribs remained constant throughout the hull, this would give an additional length of 5.50 m., and if the alphabet were to be used again twice to fore (as it had been aft) the total length of the ship would work out at some 25 m at keel level. This minimum measure would increase when projected upwards to deck-level, because frames and floors are not at right angles to the keel, but open upwards fanwise. An additional 4 or 5 m would then have to be added for the stem and stern-posts, bringing us back to a total measure of some 30 m.

Finally the width of the ship is relatively easier to estimate from the timbers in its well preserved extremity; it must have been just under 5 m. or between one sixth and one seventh of its length. The measurements of medieval and Renaissance galleys vary. The 13th century Provençal galleys built for Charles I of Anjou were one to ten; the 13th century Genoese galleys had a slightly wider beam, indeed the tendency of both Genoese and Venetian galleys during the 15th and 16th centuries was to grow progressively beamier.

Timbers: General Characteristics

Frames and floor timbers alternate throughout this hull in the manner usual in all classical ships. A peculiarity worth mentioning in connection with the floor timbers is that there is no consistancy about the limber holes, or notches, at their base. Designed to allow bilge water to circulate, such notches are only present in two of the surviving floors, nos. 15 and 17; nos. 9, 19 and 21 to either side of them are straight cut across the base (fig. 156). Since no floor timber on this ship actually touched the inner surface of the keel, the bilge could in any case flow under them. Perhaps some carpenter had cut the notches from force of habit, only stopping when he saw it was a useless waste of time. Again, the construction provides many hints that the ship had been built in haste.

As in all classical ships the timbers were cut according to a predetermined pattern rather than by " rule of thumb ". Available wood was forced to take any predetermined shape, strength being acheived by the joinery rather than by the quality of the wood that had been used. Floor timber 19 is an example of this; evidently there had been no wood large enough to make it, so an extra piece was joined onto it by mortise and tenon. Later shipwrights, by contrast, would have chosen their timber for its suitability to purpose using for instance, a forked branch to make a knee.

The Use of Putty

A peculiarity that this hull seems to share only with the Sister Ship, is the putty that was liberally used on it both as a filler and an adhesive. I have seen nothing comparable on Greek or Roman wrecks, which suggests the possibility that the feature may be characteristic either of Punic Ships, or of warships. Despite the fact that the ribs had been cut with remarkable accuracy, there were slight accidental differences between their curves and those of the waiting shell; these gaps were fllled with putty (fig. 157).

a

b

Fig. 157. – *a*) The deliberate use of putty as a sealer; *b*) the same after the removal of this frame.

Putty was also used as a kind of adhesive, to steady a timber immediately after it had been inserted and before it had been secured with nails. Fig. 36 shows large lumps of this putty adhering to both garboards, under the seatings of the floor timbers 19, 21 and 23 (which it had evidently held in place provisionally). This use of putty rather than wooden supports, again evokes hasty building which, in turn would be more explicable in a warship than in a merchantman. That large quantities of the putty were always to hand during the fitting of the timbers, is attested by the many accidental droppings on the bottom of the hull; a similar spill was found inside the prow of the Sister Ship.

The identification of this material was by no means straightforward. Having decayed, the few traces of it that remained were both ambiguous and elusive. Similarly, the body of the material being sand and lime, was very similar to a natural marine concretion. Indeed, the only sure sign that the material was man-made was its appearance, which left no doubt that it had been used deliberately. Specimens were examined in several laboratories before reaching Dr. D. H. Midgley at the Building Research Establishment, Watford, who reported as follows: " A sample of the material was impregnated with resin and a thin section prepared for microscopic examination.

The majority of the material was of fine beach sand cemented with calcite mud. The sand was identified as beach material because fresh shell fragments were found in it.

Material of a cellular nature was found and this appeared from its structure to be of a vegetable nature and probably was the remains of ' hemp '. One part of the specimen was opaque in thin section and appeared a lustrous black in reflected light. It was very slightly soluble in methyl alcohol and gave a black stain on filter paper. This was probably of a bituminous nature.

It is considered that the material was a lime putty with a sand filler and associated with strands of hemp and some tar like material ". In view of what was eventually learned about the amount of hemp, or *Cannabis*, on this ship, Dr. Midgley's observation hardly comes as a surprise, but at the time he made it he had no idea that any other hemp had been found on board. The bituminous content in the putty's binder, also evokes the substances used between the lead sheathing and the hull, and in the ' swaddling ' around the Sister Ship's ram (see below p. 263).

Ballast Stones Stuck in Putty

This putty must have been more liquid than the kind used by modern glaziers, because when dropped, it congealed into shapes reminiscent of candle grease. Further, in order for it to have been useful in steadying timbers, it must have set more quickly than modern putty. The way that twigs and branches had become stuck in the still soft putty has already been described; the fact that the stones were also embedded in it is much more surprising for the following reason. Whereas it would be possible, if unlikely, for plant material to be present in a hull during its construction, for ballast stones to have been there at such time would, normally, be out of the question. This was, however, the case and there is only one explanation: the launching of the ship must have been so urgent that the ballast had to be thrown in before the putty had hardened and while carpenters were still working on the superstructure.

James Woolfe-Murray first realized the significance of the quantities of stones stuck in lumps of putty which, on its underside bore the imprint of the wood of the hull. In only one dive, towards the end of the 1973 season, he collected so many samples that only a few of them could be shown in the photograph (fig. 34).

This is not only clear proof of a hasty launching, but it is an important contribution to the ever accumalting circumstantial evidence that points to the Punic Ship being a warship rather than a merchantman. As might be expected, the internal arrangement of its hull differs from that of other ancient wrecks.

Longitudinal Reinforcement and a Central Passageway

William Johnstone deduced that the floor timbers had been positioned after the sides of the ship had been built up to water level, i.e. streak 11. The freeboard was completed later and the frames inserted. When the skeletal parts were in place, two short timbers with holes on top (to hold stanchions) and slots cut into their undersides to fit over 4 ribs, were positioned to either side of the keel. The surviving timber of this pair, T1, was *in situ*, slotted over floor 17 and frame 18, to which it had been affixed with iron nails (now reduced to corrosion); its extremities touched floors 17 and 19, (figs. 158 and 159).

Fig. 158. – "T 1" a short timber with a hole to receive an upright stanchion, *in situ* fitting over three floor timbers.

Two rows of planks, running parallel with and to either side of the keel, were associated with these timbers. Similar rows of long and short planks parallel with the keel are known from other wrecks.

For instance on the 2nd century A.D. Procchio wreck off Elba, (fig. 160) (4). In the Punic Ship, the short planks extending the line of T1 at the level of streak 6, were made of oak. The one that survived had be nailed over timbers 37–40, but again, the iron nails having perished, it had become displaced and was found over streaks 8 and 9. A long pinewood plank probably from the outer row had been dislodged so that it lay alongside the keel to starboard (see plan, fig. 8, *2*).

Firstly, it should be noted that these four, or possibly 6, rows of nailed planks served as additional reinforcement to the keel structure. They also formed a passageway down the centre of the hull, which must originally have been separated from the ballast stones to either side by 'shifting boards'. Another wreck 'B' of Pointe de ia Luque (5) has two long planks nailed to either side of its keel between which the mast step was accomodated. There the similarities end, for in both the La Luque 'B' and the Procchio wrecks, a 'ceiling' of loose (i. e. un-nailed) floor boards takes over beyond the rows of nailed planks. The function of flooring is to keep cargo from contact with the bilge water, consequently it would have

(4) I am deeply indebted to the surveyor, Signor Gino Brambilla and to Capt. James Wolfe-Murray for personally communicating this information. See too A. Fioravanti, *Photographic Surveying of a Roman Ship off Elba*, in *Science Diving*, Ed. N. C. Flemming for CMAS, London 1973, pp. 17–18.

(5) B. Liou, in *Gallia* 31, 2, p. 579.

Fig. 159. – "T 1", the short timber for holding an upright stanchion. *Drawing by Mary Anderson, scale 1 : 5.*

been useless in the cargoless Punic Ship. Proof that no flooring was lost accidentally when this ship sank, is given by the dunnage. It will be remembered that some of the branches were even cut to fit in between the ribs.

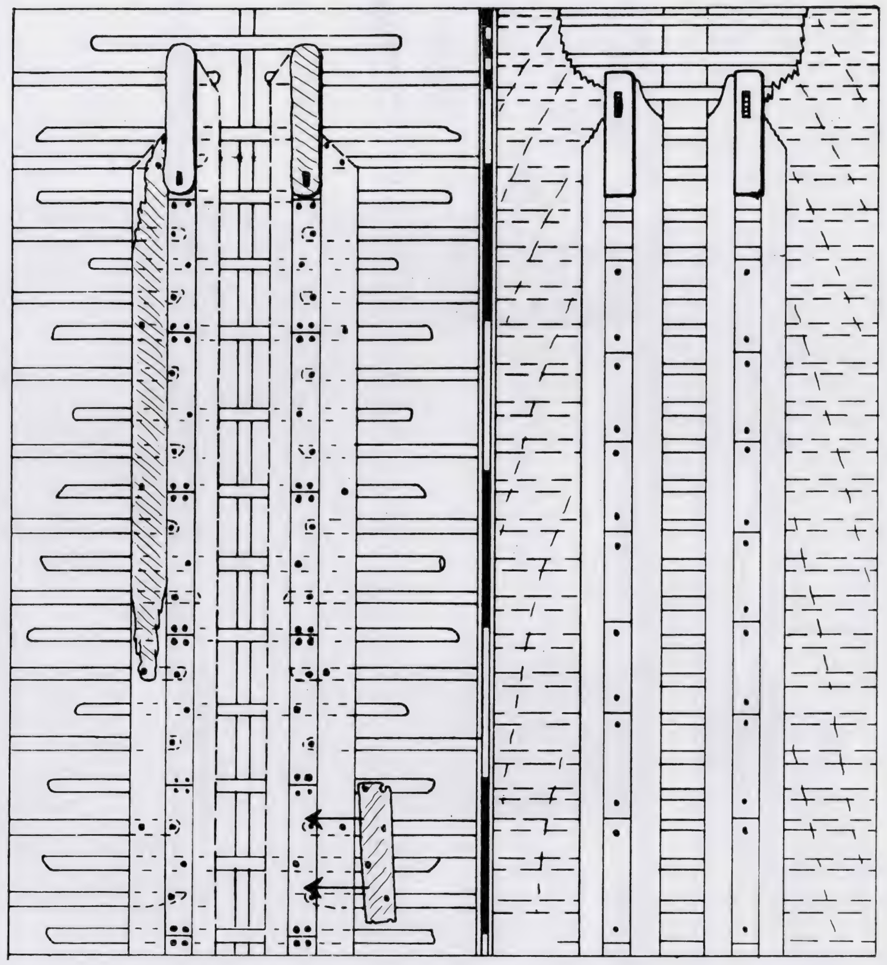


Fig. 160. - *a*) Reconstruction (1-100) of the gangways parallel to the Punic Ship's keel: of the shaded wood, "T 1" is *in situ*, but the short oak plank (bottom right) had slipped from its original position, while the long and un-mortised plank (left) from the damaged starboard side, lay on the sand near its original position; *b*) A similar arangement in the "Elba Ship" (after G. Brambilla).

There is no trace of a mast step in the Punic Ship. Warships did use sail on long journeys, but their masts were lowered when the ships went into action. Mast steps were not nailed down, so they could have been removed too, but in this case, the ship being seemingly on her maiden voyage after a hasty launching, it is more likely that no mast step had been put in. Again, the reason for assuming that its loss had not been accidental, is because none of the usual brailing rings, or any other kind of rigging was found during the excavation.

Central Storage Space and Kitchen

In narrow oared ships the only space available for cooking and storage was down the centre. Excavation proved that this had indeed been the case in the Punic Ship. The central provenance of the cordage has already been described in the chapters on organic materials. The distribution of the ship's crockery (see fig. 73) and particularly the kitchen tiles corroborates this evidence. The heavier pottery, because of its weight, had been projected beyond the light vegetable matter. The latter had survived because it had either been sucked under the ship when she broke, or it had been trapped by the ballast stones. When the ship's stern became stuck into the bottom at an angle of 7° and the hull heeled over to port, the kitchen tiles were projected outwards and to port. A glance at the distribution plan shows them together with some of the heavier pottery lying to port at square E–H, 31–33, level with the break in the hull; their original position would have been the centre of the ship.

In wrecks of merchantmen, kitchen tiles are invariably associated with the stern. Because no other warship has been found, no architectural comparisons exist. The interest lavished by scholars on the hypothetical banking of oars has left no time for questioning the other parts of ancient warships. Something is however known of medieval galleys, descendants of the earlier Liburnians and Dromons. Enrico Scandura neatly summarises the relevant information in a chapter on "the Maritime Republics: Medieval and Renaissance ships in Italy" (6). Referring to 14th and 15th century Genoese and Venetian galleys Dott. Scandura describes a main gangway some 2 m. wide running from stem to stern at about a metre above the deck level. Its planking was removable so as to give access to a coffer shaped locker beneath. The rowers' quarters and kitchen took up the centre of the galley. Below deck there were usually compartments including pantries, storage lockers and a room for the sick and wounded. Indeed it could hardly have been otherwise on a warship, given the ballast stones below and the space required by the oarsmen and fighting men above. Renaissance galleys were, however, at least one metre broader than the Punic Ship in which the central passageway between the partitions separating it from the ballast stones seems to have been no more than 1.50 m. wide. No trace was found of 'shifting boards', but as the name implies they are removable, therefore liable to be lost during sinking.

A Wale

Two lengths of wale together measuring just under 9 m, were associated with the site. The larger, TX 7, was found to landwards of the main wood, towards the Sister Ship (Distribution Plan ... T–V, 30–34). The shorter, TX 8, had been washed onto the shore opposite the Punic Wreck, where it had been naturally preserved by drying out slowly under the piles of *Poseidonia* leaves. The inner face of TX 7 had retained the curve of the hull, but TX 8 had warped while drying. Otherwise, there had been no deformation so that the spacing of the mortises and the sectional measurements of both timbers remained identical. The outer face of TX 8 was, however, so worn as to make it difficult to distinguish all the external dowels which, as in TX 7, must have attached a structure to the outside of the ship (fig. 161).

(6) *A History of Seafaring*, Ed. George F. Bass, London 1974, p. 206 ff.

Fig. 161. - The two sections of wale (scale 1 : 20); note the imprint of an internal cross timber in the putty (top left) and the signs of wear on the outside of this same TX7 (see Plan fig. 73, no. 14).

The two timbers are certainly parts of one and the same wale, but not having been found *in situ*, it is impossible to be certain which of the two contiguous wrecks they belong to. Some botanical evidence points to the Sister Ship because like her two ribs, the wale is identified as oak of the *cerris* type. Though no *cerris* was identified in the Punic Ship's main structure below the waterline, there was some in the dunnage (Table III, p. 80) and in the fragment of timber mentioned below p. 264. Further, a dowel, made of olive wood, in the wale is paralleled in the Sister Ship whereas in the Punic hull they were oak. The 12,5 cm. dowels from the wale were also longer than the 0.6 cm variety used in the Punic Ship's hull (see Table IV, p. 265). This evidence is, however, inconclusive, because not every timber from the ships was submitted for identification, so that some from the Punic Ship might have been *Quercus* of the *cerris* type. The size of the dowels is also inconclusive, because loose 12.5 cm dowels were excavated on the site of the Punic Ship in sufficient quantity to suggest that, like the iron nails, they had been used in parts of her superstructure.

Supports for the Fighting-Deck?

Doubt must persist as to which of the two ships—both oared and both shown by painted signs to be Punic—this wale belonged. Structurally, the Punic Ship must have had a first wale above the spray deflectors that marked her waterline. In the circumstances, we must extract what information we can from this wale and apply it, with reservations, to either ship.

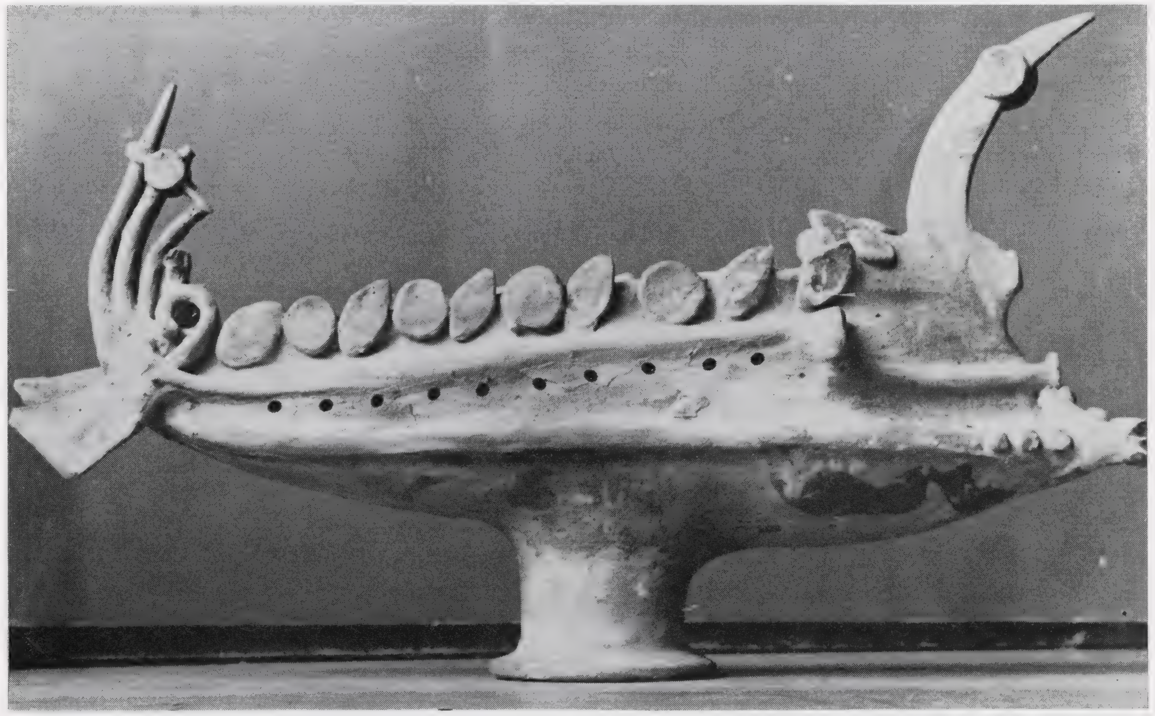
As is usual, the wale is joined to the strakes above and below it by dowels and tenons. The face showing inside the ship has a thin covering of putty in which can be seen the imprint of a timber. This being on the upper edge, the timber must have been a cross-beam from the superstructure. On the outside of the ship, the protruding part of the wale is not on the horizontal; it had been given a slight upward slope, presumably the better to bear the structure that it supported. That it did carry some kind of structure is shown by both the iron nails and the dowels driven into the wale from the outside.

Deliberately cut notches show on the upper and outer faces of both lengths of wale. For want of comparisons, an indented cutting at a broken end of TX 8 at present defies interpretation. Otherwise, its exterior is too weather-worn for any of the shallower groving, such as visible on TX 7, to have been preserved. V-shaped cuts show in a concavity in the upper and outer faces of TX 7; the concavity itself is worn down by rubbing; to either side of it are the remains of grooves such as would be made by the localized rubbing of a rope which evoke vertical undergirding by hypozomata (7) (fig. 161).

The main interest of the wale certainly lies in the spacing of the dowels on its outer face; they are the only clue to the structure it must once have supported. Three couples of dowels some 1.50 m apart survive on TX 7. In two of the couples, the dowels themselves are 11 cm apart, but in the couple that coincide with the internal imprint of the timber from the superstructure, the dowels are 27 cm apart. Single dowels are implanted centrally, between the couples. On TX 8 the same spacing of 1.50 and 75 cm is echoed, but no coupled dowels have been recorded; the surface being badly worn, this does not prove that they did not once exist. If a dowel falls out of ancient waterlogged wood, and that wood subsequently dries, the dowel hole will shrink and close up. Further, when a draftsman examines any very long timber, he records what he can measure; interpretation can only start once his

(7) Kennedy Don, H., *Cable reinforcement of the Athenian Trireme*, in *The Mariner's Mirror*, 62, 2, 1976, p. 165.

measured drawings of tracings have been reduced to a manageable size. By this time the wood in question will be inaccessible, being either in storage or in treatment tanks so that it is impossible to re check points of detail until the wood has been conserved, that is to say some years later when the ship is being reconstructed. Meanwhile it is reasonable to assume that the joinery is alike on both lengths of this wale; the worn and the well-preserved.



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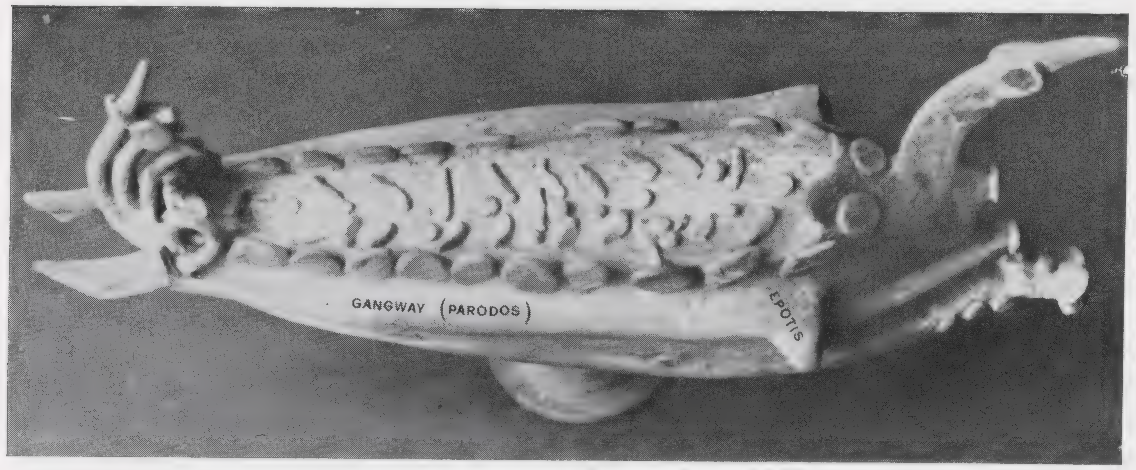


b

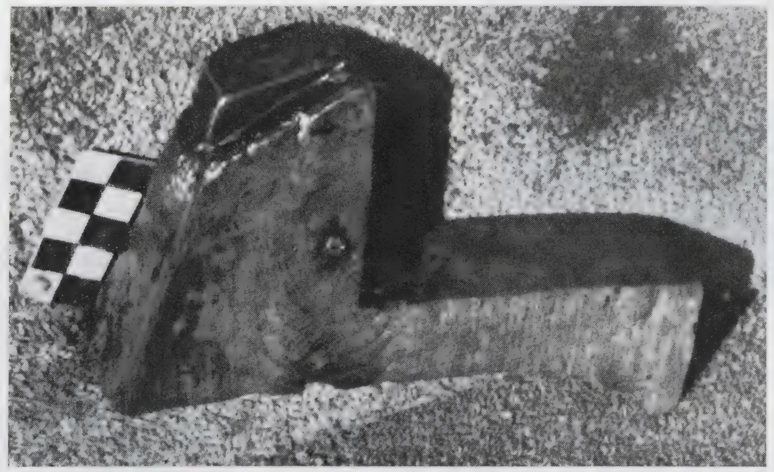
Fig. 162. – *a*) I am indebted to M. Lucien Basch for these photographs of the 3rd century B.C. clay model of a ship now in the Louvre, Paris (for details of this model see the article by L. Basch quoted on page 259); *b*) Seen from above, view B, two external gangways, or fightingdecks show outside the row of shields; the oarsmen's benches may be represented by the roughly modelled lines inside the ship. Most of the painting on the outside of the model has disappeared, but oar-ports (as added in ink on the photograph) may once have been indicated beneath the fighting-deck.

An outrigger is the most obvious external structure to have been supported by this wale, but whether the outrigger took the form of a fighting-deck (as in Lucien Basch's interpretation of the Louvre model) (8), (fig. 162) or whether it carried the oars, is uncertain. Assuming that TX 7 and 8 represent the lower wale, its external dowelling might have attached the bottoms of the brackets that carried the outrigger. Since the oars must have come between these brackets, the single dowels, that come between the coupled, might have been connected with come kind of oar-port or rowlock. The 1.50 m space between the coupled dowels is a reasonable distance between oarsmen, but being on the generous side, it suggests that there may have been two men to each oar, which in turn implies that on a ship of this width there would have been a need for a fighting-deck. Further speculation is useless; the alternatives need to be tested on an experimental model.

Two Scraps of the Superstructure

The first consists of a scarphed, 47 cm section of narrow maple wood planking; it was found under the hull, beside the besom (figs. 163 *a* and 73 P 15). Though only 6,5 cm wide, this planking (P34/74) is disproportionately thick (3 cm), while the tenons are as large as those used in the main hull planking. The scarph, like all the other scarphs in the main

a



b

Fig. 163. – *a*) Narrow planking from the superstructure (P 34); *b*) A bracketshaped piece of wood with an iron nail from the superstructure (P 35).

(8) L. Basch, *A Model of an Ancient Warship in the Louvre*, in *The Mariner's Mirror*, 52, 2, 1966, p. 115.

hull, has been steadied with a nail, but in this case the nail is iron and not bronze (presumably because these planks did not come in contact with the water).

A bracket shaped piece of wood (P 35/74) (fig. 163 *b*) very similar in appearance to maple and also containing an iron nail was found in a similar context: the kitchen area. As yet, neither of these finely worked pieces of wood can be interpreted; they are put on record in the hope that comparisons will be found on some other wreck excavation.

A "Shield Holder?"

Of more striking interest is the top of an elaborate walnut wood timber 51.5 cm long (T2/74), through which is threaded sets of double, plaited cords made of esparto grass and held in place by small wooden wedges (fig. 165, see too fig. 73 N. 13; possibly the aftermost stanchion, hence its curvature).

Fig. 164. – The wash-board structure in a Maltese fishing boat.

Two sets of these double cords occur in the upper, free-standing part of the timber; below them it had been attached by iron nails to some, presumably, horizontal bar. Below the nails the timber is broken through yet another hole that also contained the remains of cords, which suggests that there must have been one or more sets of cord filled piercings in the missing part. There are signs of wear beneath the well-preserved sets of cords, showing that whatever they had held had rubbed against the wood. The cords themselves are of the medium 6 mm variety shown in James Wolf-Murray's typology (fig. 43).

Because both archaeologists and laymen seem most interested in the oars of a warship, all who saw this timber immediately suggested that it must be a rowlock. But this interpretation is unlikely in view of its shape and the thinness of the cords. A somewhat less fanciful suggestion is that it might have been one of the stanchions, ranged along the sides of warships, from which shields were suspended. Stanchions at deck-level exist on many contemporary, Mediterranean craft. On the Maltese boat fig. 164 they are slotted into a wale at deck-level where they hold wash-boards (the latter being slipped into vertical groves cut in the stanchions). In the Eastern Mediterranean, canvas is usually substituted for boards and has therefore to be tied to the upright supports. The practise of hanging shields around ancient warships is well known from their representations on coins and elsewhere. Shields would have had to be even more firmly tied—and to a stouter stanchion—than canvas. The large size and multiple cordage on the walnut wood timber are consistant with this use.

A comparison has recently been found for the threading of a cord, or sennit, through a timber; for this cord lying in a notch and for its being held in place by dowel-like wedges.

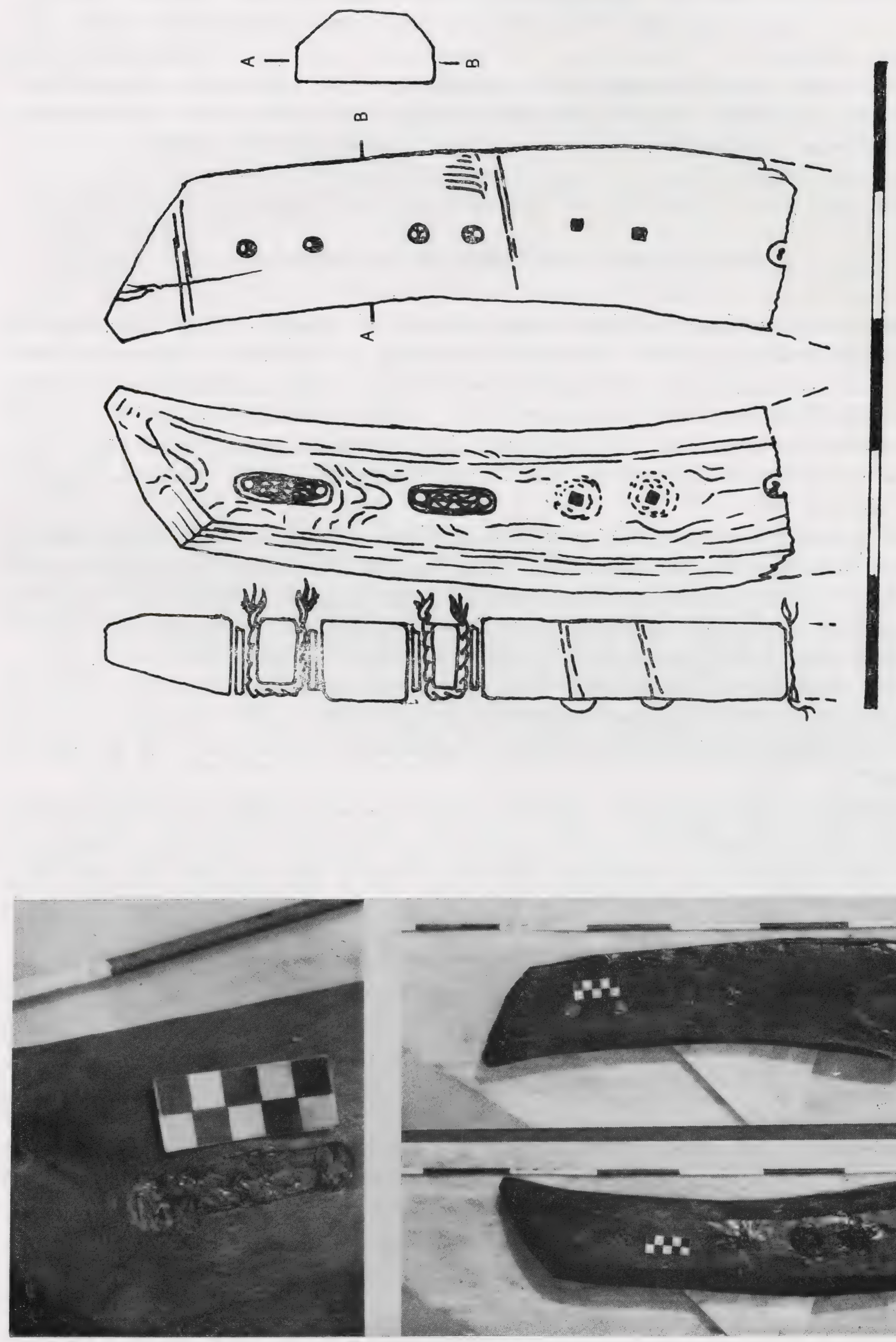


Fig. 165. – T2/74 the "shield-holder": *a*) detail of the two plaited cords secured by wedges; *b*) as seen from the inside (top) and the outside; *c*) drawing of same.

Here the comparison ends, because the new findings are too different in other respects for them to present an alternative interpretation to our T2/74.

This new evidence comes from the wreck of a late second or early third century B. C. cargo ship, published by F. Carazé (9). He describes as ' repairs ' two reinforcing frames that are sewn onto the hull planking, by a continuous cord, through regularly spaced holes. These timbers are placed alongside the original frames of this ship which was evidently old when it sank. Again unlike T2/4, these ' repair ' timbers were not nailed.

The Outside of the Hull: Lead Sheathing

Sheets of lead secured by bronze tacks, covered the outside of the hull and the bevelled spray deflectors, as well as the keel, including its underside. There is no trace of either lead or tacks on the two lengths of wale found on the site, though to judge by the Nemi ships, first wales were covered with lead. Pending the publications of the Kyrenia Ship, the Nemi Ships are the best comparison we have for sheathing; divers know more about the insides than the outsides of hulls, because unless a wreck is raised the inside is all that they can see.

Peter Brachi, draftsman during the 1973 season when most of the Punic Ship's planking was raised, noted that his drawings of the outer faces of all fragments of strakes showed: " not only the tacks, but the holes where the tacks had apparently fallen out. Sheets of lead, apparently rectangular, had been fixed to the planking by a continuous row of closely spaced tacks around the perimeter and a diamond pattern of tacks about 8-10 cm apart across their expanse. In several cases there are horizontal strings of tacks. When all this information can be assembled (possibly on a large scale model, certainly when the ship itself is being reconstructed) it should be possible to estimate the size or sizes of the sheets ".

Meanwhile it is interesting to compare his observations with Ucelli's very similar description of the Nemi sheathing (10) " lead sheets 1 mm. thick and about 1.50 m. high were applied with precision in a transverse direction, covering the keel and the first wale. Starting from the stern, the sheets were laid so that the water could flow freely across them as the ship travelled without being interrupted by the overlaps. After the main expanse of hull had been covered the keel and the wale were sheathed independently. The attachments were effected by a double row of nails, very closely spaced along the edges of the sheets and more widely spaced within ". Some scored lines to guide the placing of the tacks were still visible on the Nemi lead (which having been found in freshwater, was in a good state unlike the powdery remains on the Punic Ship).

Ucelli mentions only the length of the Nemi sheets, and until the model of the Punic hull is completed I can find only an indication of the width of its sheets: 1.20 m. This occurs on P30 (a section of strake no. 13) where two vertical lines of closely spaced tacks appear on the same length of wood.

(9) F. Carazé, "The Jeaune Garde B Wreck", in *IJNA* 6, 4, pp. 299-303, 1977.
(10) Ucelli, *Navi di Nemi*, p. 135.

Woven Fabric Impregnated with Resin between the Sheathing and Hull on both the " Punic " and the " Sister " Ships

During the excavation we repeatedly saw the remains of a woven fabric between the lead sheathing and the hull, but its fibres were too decayed to be identifiable. It has, however, been possible to form an idea of the resin with which this fabric was impregnated, from samples taken from the Sister Ship which were in a better state of preservation. I must therefore, in discussing this resin, anticipate the description of the Sister Ship given below (p. 265).

Samples from both ships were submitted to Mr. Raymond White (Senior Scientific Officer, the National Gallery, London). First the organic material that wrapped the ram of the Sister Ship was " separated from fibres and inorganic concretions by extraction with chloroform, and the extract then further extracted with methanol. This methanol extract was treated with diazomethane to convert any acids present to methyl esters and then subjected to gas-chromatography, yielding a chromatogram. This shows the diterpenoid resin acidesters typical of pine resins and is comparable with that from a recent pine resin. The resin has been well protected from oxidation, presumably because of immersion in sea-water. Also the non-conversion of all the abietic acid to dehydroabietic acid indicates that the resin was not subjected to strong heating in course of application. The many small additional peaks therefore most probably arise from the addition of soft-wood tar which would produce a more liquid composition, workable at a lower temperature. It woluld also have contributed good preservative properties, though this may be incidental.

The pine species cannot be identified with certainty since the European species have basically similar compositions. However *P. Sylvestris* and *P. Pinaster* seem unlikely on account of the low level of primaric acid observed, but *P. Halepensis*, the Aleppo pine, which is common in countries bordering the Mediterranean, is a strong possibility ".

It will be remembered, incidentally, that the ram itself was probably made of pine of the " Ponderosa " group which includes *P. pinaster*, while the planking of this Ship was pine of the " Sylvestris " group; the planking of the Punic Ship was of the group that includes *P. nigra* and *P. Sylvestris* though this, of course, in no way excludes the possibility of the most suitable type of resin having been extracted from the Aleppo pine. It is, however, worth mentioning because of the doubt attaching to the second sample (SI/139/71) which Mr White describes as: " something of a puzzle, and likely to remain so, unless by chance we happen to come across a known resin that behaves in the same manner.

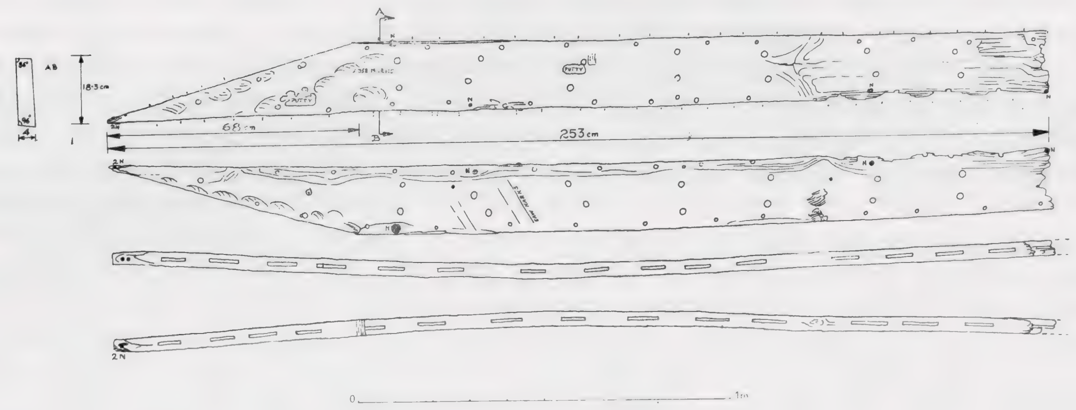
Certainly from its properties one is inclined to suggest that it is a resin. The gas chromatogram, is however, very curious for there only seems to be one main acid component, which cannot be identified. It is not a typical *Pinus* sp. I think all we can say is that it appears to be resin, probably diterpenoid ".

The Nemi hulls had been " covered with a waterproof mastic made essentially from a vegetable, or naval pitch derived from the distillation of a coniferous wood ". Onto this was spread a fabric woven from finely carded sheep's wool impregnated with a waxy, bituminous material (11). The lead sheathing was then affixed, though what purpose it served in the freshwater lake where there are no xylophageous molluscs is a puzzle, unless it was no more than a means of protecting the waterproofed fabric which might otherwise have worked loose.

(11) Ucelli, *op. cit.*, p. 153

A Link with the Sister Ship: simultaneous Sinkings?

A plank 253 cm. long P 33/74 (fig. 166) differs from any other in the Punic Ship, though it was found loose on the site (fig. 73 squares P–Q. 32–33). It was excavated towards land, level with the break in the hull, on the southern limit of the wreck, i.e. in the direction of the Sister Ship and not far from the place where the wale was found. The edges of this plank were angled in such a way as to suggest that its original height, relative to any hull, must have been 5 to 10 strakes up from the keel.



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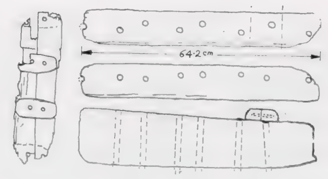


b

Fig. 166. – Strake P33/74 found on the Punic Ship, but detached; possibly from the stern of the Sister Ship; *b*) fragment of timber with planking attached from the Sister Ship area; note the different arrangement of the dowels and the absence of nails.

Adze marks show its outer end to have been a butt joining the sternpost, rather than a scarph. Along the edges of the plank both the tenons and the intervals between them are larger than those on any strake in an equivalent position on the Punic Ship, though they accord with the measurements I took on the planking at the prow of the Sister Ship. The 8 ribs that crossed this plank had been much the same distance apart as those on the Punic Ship, but no nails passed through the dowels that had attached them. Five nails however, had been driven straight through the wood at irregular intervals, but always coinciding with the seating of some rib. The lack of nails within the dowels is typical of the Sister Ship's structure where no clenched nails were visible on any of the ribs on the surface level that we examined; it is therefore almost certain that P33 had been washed onto the Punic Ship from the Sister Ship.

" Sister Ship "

Identifications by Plant Anatomy Section, Jodrell Laboratory Royal Botanic Gardens, Kew.

Site no.	Description	Provenance on site	Identification	Lab. date
SS/ /74	Plank	prow	*Pinus* of the " *Sylvestris* " group	28.1.75
SS/ /74	Rib	loose	*Quercus* of the Q. *cerris* (southern) type	
			Quercus of the Q. *cerris* (southern) type	
SS/ /74	Dowel	*in situ*	*Olea europaea* L.	
SS/ /74	Ram	*in situ*	*Pinus* sp. probably the " *Ponderosa* " group which includes the maritime pine *Pinus pinaster* Ait.	

Both ships had met an unusually violent end, (see pp. 40, 57 and below) in the sense that their remains gave evidence of deliberate sinkings rather than the natural breaking up of a hull tossed onto the shore by storm waves. It is therefore significant that this plank (assuming that is comes from the Sister Ship) should be mingled with the ballast and the pottery on the site of the Punic Ship. The two sinkings must have been very closely related —if not simultaneous. This not only adds to the evidence for both ships being warships, but it further implies that both went down in the same engagement.

The Sister Ship

I have already referred to the site of the Sister Ship, some 70 m. to the south of the Punic Ship (see p. 19); its remains were first revealed in 1973, when the sand bank which moved onto the Punic Ship had in so doing drained sand from the other wreck. In 1974 when the sand bank retreated from the Punic Ship, the level above the Sister Ship was further reduced. I will now summarise the similarities and differences between the two wrecks.

A glance at the plan made by John Wood in 1974 (fig. 167) shows the Sister Ship's keel to be in two parts lying at right angles to each other, suggesting that the ship had received some shock amidships—a shock so violent that it had snapped the keel like a matchstick, crushing together the port side ribs. The violence of this impact (like the impact that had driven the stern of the Punic Ship into the bottom with such force that it remained there at an angle for two millennia) is inconsistent with the natural breaking up of a hull. The crash that sank the Sister Ship was probably also responsible for the immediate burial of her extremities and consequently their preservation. Ramming would explain both sinkings.

A dissimilarity between the two wrecks that at first puzzled me, was the seeming absence of ballast on the Sister Ship. A few large stones were present, but no massive pile such as marked the site of the Punic Ship. Only later did I realize that in order to examine any of the wooden structure in the central part of the site, I had to take my knife and cut out

chunks of clay. This clay had in fact served as ballast instead of stones. This not only means that her hull should be even better preserved than the Punic Ship's but also that a microscopic examination of the clay should give a good indication of where it came from.

The hand sounding that I was able to make on the prow of the Sister Ship in 1974, after the close of the Punic Ship's excavation, produced evidence that both wrecks were Punic and both of the same period. Again, it is an alphabetic sign, another Phoenicio-Punic *waw* painted onto the starboard tusk of her ram that proves this (see fig. 169).

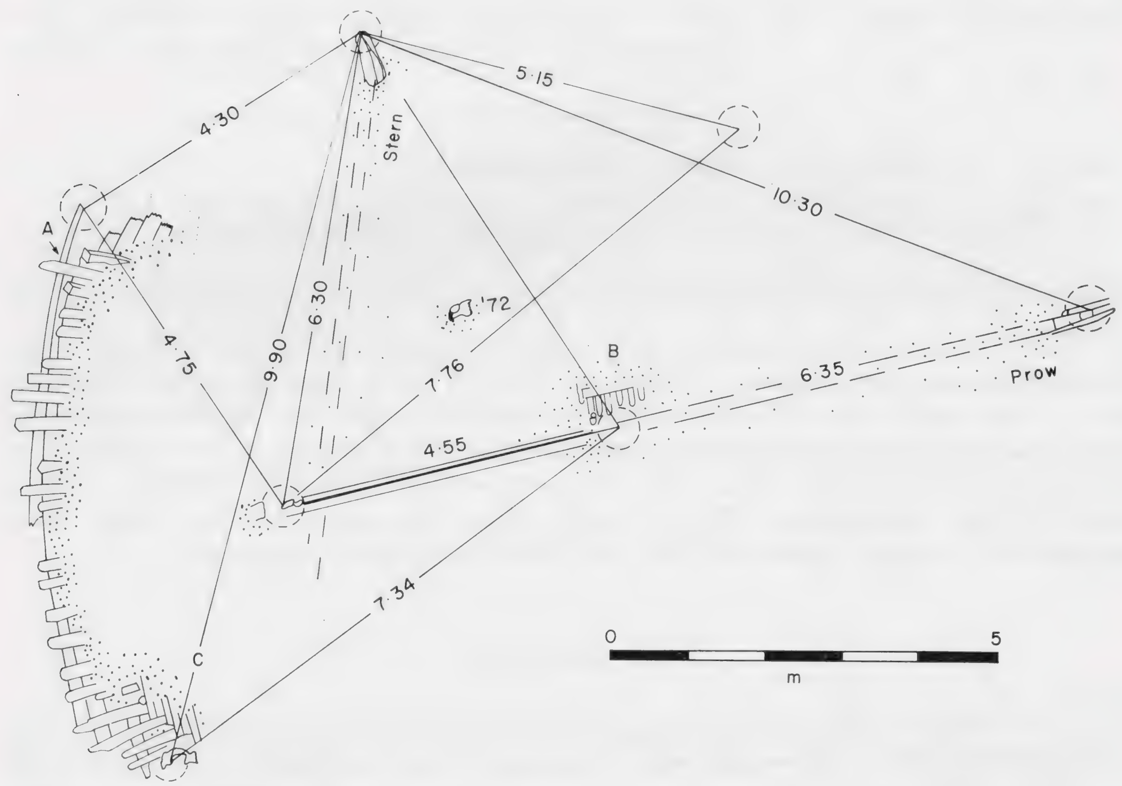


Fig. 167. – The Sister Ship; plan by John Wood: A) a wale; B) inner floor boards or ceiling (see fig. 171); C) the fluke of a broken anchor probably from a modern fishing boat.

That both ships are of the same period is shown by both sets of potsherds, for instance: an amphora body sherd and a base SS/3 and 4/74 from the Sister Ship, are comparable with the Greco-Italic specimens such as S1/71/71 from the Punic Ship. The body sherd of a grey, cigar-shaped Punic Amphora with a shaven surface SS/1/74 is comparable with S1/212/74. A pantile SS/5/74, cream coloured and badly fired, containing large reddish and brown inclusions and many large air bubbles, matches S1/652/74. Indeed all nine sherds from this sounding have equivalents on the other wreck, with the single exception of the body sherd of an *ole*, SS/2/74, of fine red paste with small black grits and a bright yellowish cream slip. Previously the top half of a Dressel 1A type amphora had been raised from the then buried Sister Ship; at the time it was registered as out of context and numbered: 10/72. It is of course comparable with S1/338/74 found in a closed context on the Punic Ship, but No. 10 remains a surface find and consequently inconclusive.

The structure of the ram (a hitherto unique discovery) is shown on fig. 168, which is based on the measurements that I took underwater (only the starboard tusk of the ram having been raised fig. 169). Fig. 151 *b* represents the extent of the sounding that I made. In 1974 when the sand was at its lowest, all that shows in this photograph was buried to a depth of about 1 m; only a few centimetres of the tip of the stempost protruded above the surface, the keel itself being at an angle running downwards towards the ram.

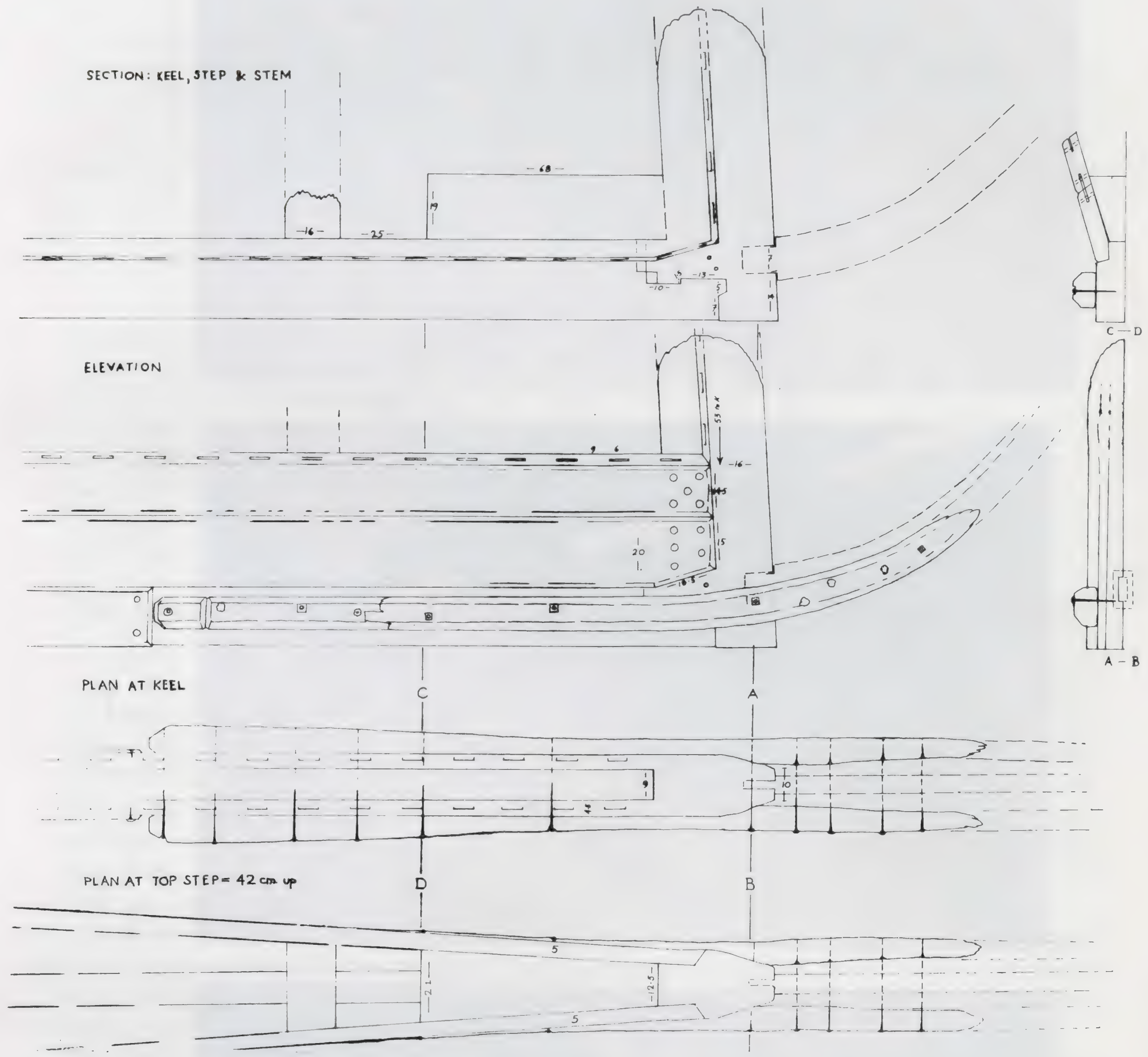


Fig. 168. – The ram structure from measurements taken underwater.

The ram is an appendage to the ship's basic structure; it is not an extension of the keel itself. Had it been an extension of the keel the act of ramming would have been equally dangerous to the attacker as it was to the attacked; this now appears as a statement of the obvious, but representations of similar rams have, in the past, been interpreted as extensions of the keel itself. Like a boar's tusk, this ram was designed to attack the vulnerable underbelly of a ship (fig. 172). The two tusk-shaped timbers nailed to either side of this keel are

Fig. 171. - The inner floor, or ceiling of the Sister Ship (B on fig. 167).

Fig. 170. - The mortise cut into the base of the stern-post suggests that there had been a central timber between the "tusks" of the ram. Note the *wow* painted onto the starboard tusk (bottom left).

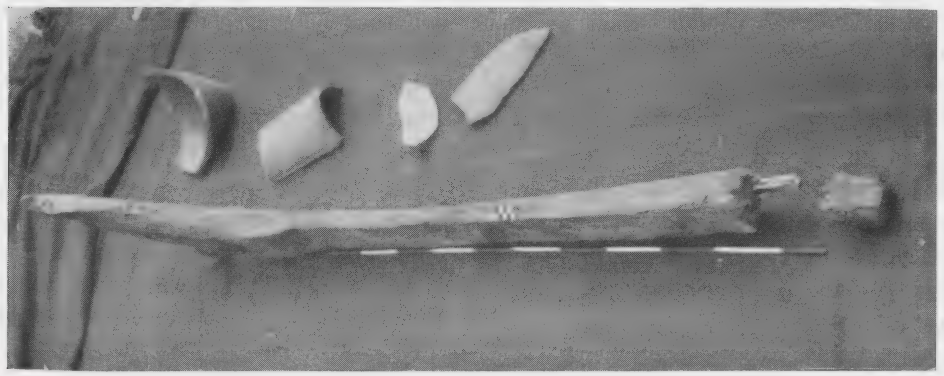


Fig. 169. - The starboard "tusk" of the ram (the only part to have been raised in 1974) together with associated pottery from the same sounding.

made of pine, probably of the *ponderosa* group which includes the maritime pine *Pinus Pinaster* Ait. (see Table IV p. 265), a pine not identified elsewhere on either wreck. The wood had been cut across the grain so that the tip would easily snap after piercing an enemy ship.

There had been a central timber between the two tusks; though this was missing, a mortise slot in the stempost fig. 170 and the nails in the tusks show that it must have existed.

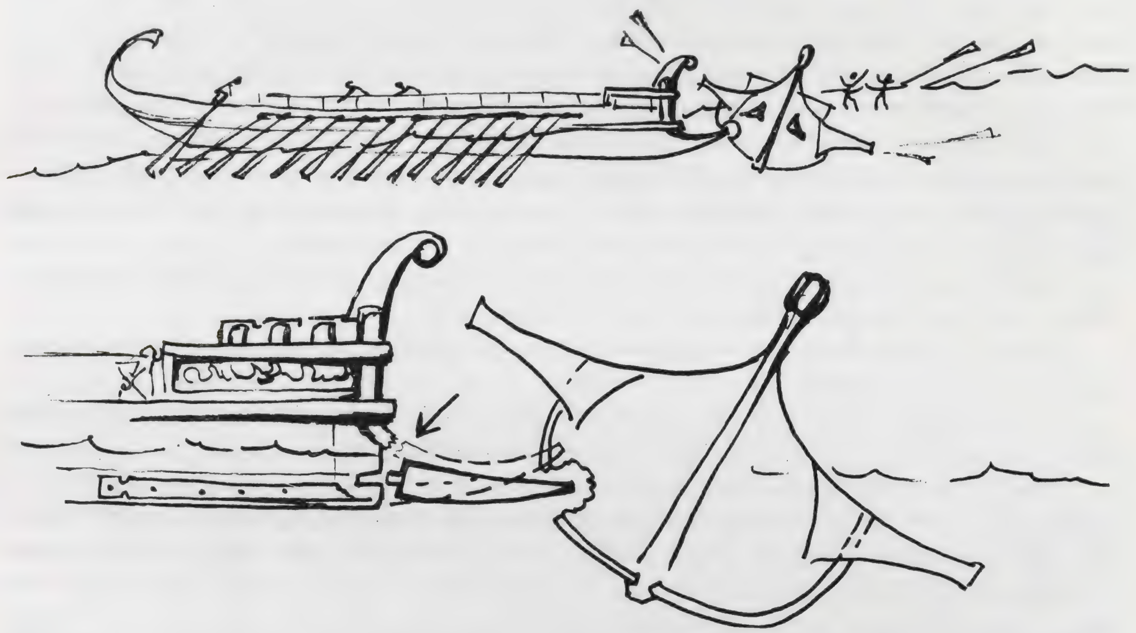


Fig. 172. - The function of the central timber of the ram (after a sketch by Hanneke Boom kindly communicated by James Wharram Associates).

Thick layers of some woven fabric, liberally smeared with resin (see above fig. 170 and p. 263), swaddled the entire ram and extended beyond it over the tusks where these were nailed onto the sides of the keel, and even onto the garboards above. This material, the remains of which can be seen above the starboard tusk in Fig. 170 was so thick that I had to scrape it off in order to see the tusk itself. The substance which has the consistency of chewing gum, is whitish in colour and retained its elasticity even after drying out in the air (see fig. 65).

Part of a small sheet of bronze with this resin still attached to it was found in the gap between the stempost and the starboard tusk, evidently it had been part of the bronze sheeting that covered the ram. Torr, with his usual perspicacity, had deduced such sheathing from the weight of a " bronze ram " given as merely 77 kg.: " the metal could only have formed a sheathing round a core of timber " (12). The extent of this sheathing on the Sister Ship is, of course, implied by the extent of the resin remains which is must have covered.

On the hull itself there is no sign of lead sheathing taking over from the ram's bronze sheathing, nor is there any sign of lead elsewhere on the site. The presence of lead is usually apparent, even on the surface level of a wreck, so that though the Sister Ship has not been excavated, it is probable that her hull had never been sheathed.

(12) C. Torr, *Ancient Ships*, London, 1894, p. 63.

From the appearance of the ram, Lucien Basch suggests that the Sister Ship was a kind of liburnian (13). The rams on all the various forms of liburnia represented on Trajan's column are the same, and in turn all resemble the form of ram found on the Sister Ship.

The Punic Ship may also have been a liburnian, but of a lighter class than the Sister Ship which, even from superficial examination appears to have been the heavier vessel. One similarity of detail, but a significant one, has already been mentioned: the use of putty on both hulls. Otherwise, in assessing the following comparisons it must be kept in mind that the Sister Ship has not been excavated. The width of the ribs on both ships is the same: 10-12 cm, but the intervals between them are slightly greater on the Punic Ship. The widths of the strakes (from the two that can be measured beneath the wale on the Sister Ship) are 18 and 20 cm. i. e. in the same order as those in the Punic Ship. The part of the wale that is still *in situ* on the Sister Ship measures 12×21 cm in section, which corresponds with the sectional measurements of the two lengths of wale described above. But sectional measurements are probably characteristic of most wales; the details of the joinery on the Sister Ship's wale cannot be examined until the ship is excavated.

A striking difference between the two ships is the presence of an inner flooring, or ceiling, in the Sister Ship (fig. 171 and B on fig. 167).

Another feature absent on the Punic Ship is the notches cut into the group of ribs (at B on plan, fig. 167) possibly to hold a rider.

Another notch is cut into the inside face of the keel at a distance of 10 m. from the prow; it may be connected with the seating of the mast step.

Finally the sternpost of the Sister Ship appeared to differ in several respects from its neighbour. I had the impression that, in elevation, the timber was slightly curved, also its inner face was wider than the Punic Ship's. Very little of this sternpost protruded above the sand and there was no way of telling the height of the visible portion above the buried keel. The differences would be explained if this part was further from the keel than its equivalent on the Punic Ship. It is impossible to say more without excavating the Sister Ship.

HONOR FROST

(13) L. BASCH, *op. cit.*, *IJNA* 1975, p. 216.

XIV. CONCLUSIONS

THE SHIP'S DIMENSIONS

The architects' final calculations give the length of this ship as 35 m. with a beam of 4.80 m. and a length to breadth ratio of 7.29. The waterline is located at 1.20 m. and the displacement is estimated at 120 metric tons (fig. 173). As explained in the foregoing chapter it had always been apparent that this was a long, narrow, fast, oared ship. As soon as the 1:5 drawings of the excavated wood became available, this was further confirmed by a preliminary model built by Mr Austin Farrar FRINA (fig. 175), but it took 4 more years of testing by the three experts involved to establish the figures given above. They are the combined results of M. Paul Adam's mathematical calculations, tested against a series of scale models built by Dr. Frank Howard (fig. 174). Although the prow of the Punic Ship was missing, it was virtually certain for iconographic reasons, as well as the straight-sided planking, that the stempost must have been vertical. Such a stempost existed on the Sister Ship; when it was applied to the portion of the Punic Ship the lines were seen to accord. The miniature replicas of the strakes had show no sign of having to be forced edgewise; they curved into their places by simple bending along their longitudinal axes.

The ship must originally have been built in haste, but well built and conforming to a predetermined pattern of considerable sophistication, its spray-deflectors in particular are a rare feature and one that has never before been found on an ancient wreck. Their utility on a ship with a fighting-deck for the use of armed men who wanted to remain dry is, however, apparent. It is the shape of this ship that constitutes the main proof that it was not a merchantman (because there was no room in it for cargo) but even before its lines had been worked out from the records of the excavated wood, the rest of the findings had provided massive circumstantial evidence to support the same conclusion.

Like any ship that sinks in shallow water near the shore, the valuables which in this case must have been armaments, had been salvaged, but what remained on board still bore no relation to the usual contents of the many wrecks of ancient commercial ships that have been found hitherto. This ship had carried ballast instead of cargo, the crew had lived on meat rather than fish and cereals (which hooks and grinders show to have been the usual diet on board merchantmen). Further, there are no large cooking pots; all this ship's crockery is small, even the mortar is more suitable for making a sauce than for preparing a mess of pottage. There was no large dolium for storing water; instead all the liquids were kept in a variety of amphorae and these, unlike a standard commercial consignment were not sealed with pozzulane stoppers above their corks, indeed the larger Punic amphorae seem to have had lids.

It is difficult from the broken remains to tell exactly how many amphorae were carried on board, but a count reveals 41 peg-bottoms of the Greco-Italic variety; the 10 lips of Punic " thin ware " each slightly different from the next; parts of 6 Greco-Italic amphorae

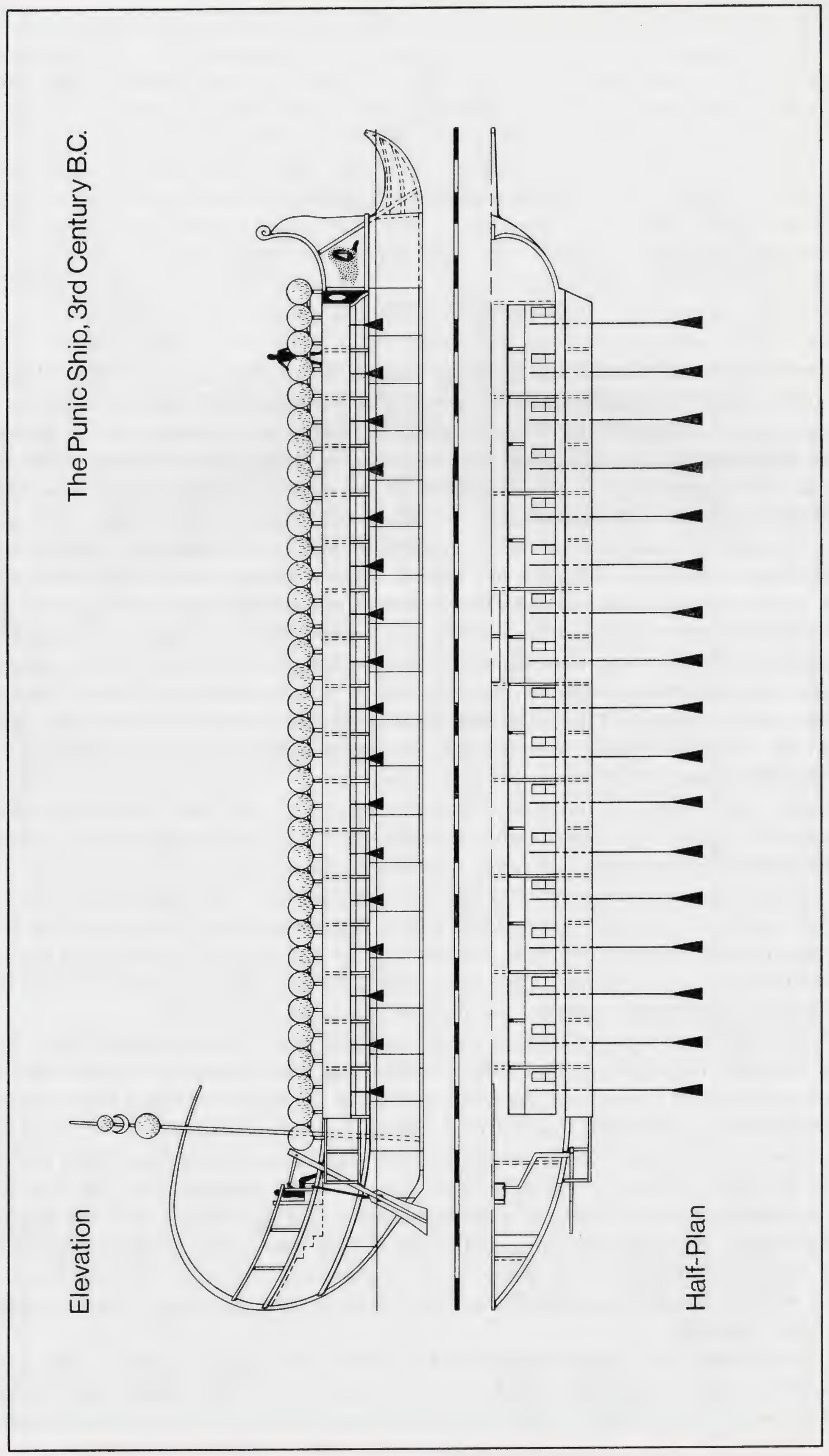


Fig. 173. – Reconstruction of the Punic Ship drawn by Michael L. Leek in 1977.

Types 1 and 2 and making an allowance for the other sherds, suggests an estimate of less than 100, probably about 74 jars. This raises the question of how many men were on board.

If we accept the 1.50 m. spacing of the oars (as suggested by the portions of wale), on a ship of over 30 m we could expect at least 17 oars to a side. But the 1,50 m. spacing

Fig. 174. – The beginning of the reconstruction: a tentative half-model of the stern up to the wale (i.e. below the oars) by Frank Howard (working on lines deduced by Paul Adam).

suggests 68 rather than 34 oarsmen, or two rather than one man to each oar. The complement of fighting men may have been around 34; if as is likely, half the oarsmen fought during an engagement, 102 men can be regarded as a minimum.

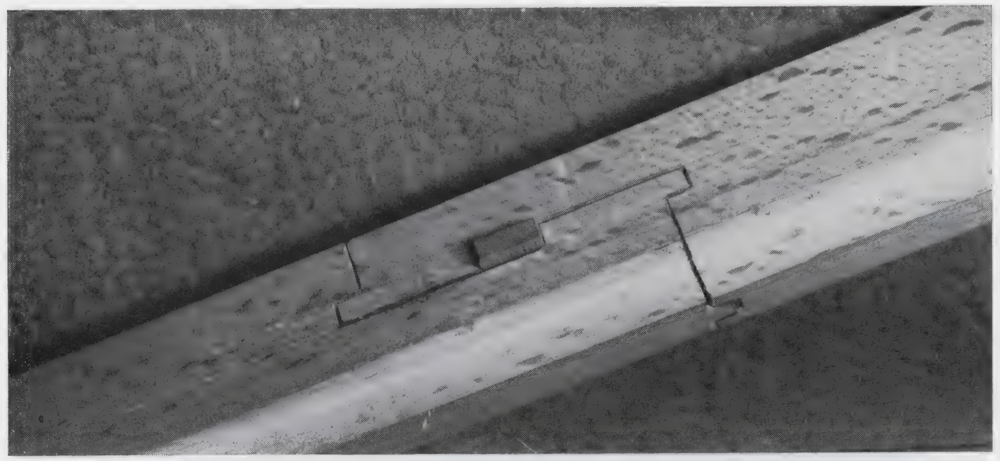
Dating

The dating of this wreck rests on four sets of evidence: the Carbon 14 tests, paleography, the possible historical context and the pottery which is difficult to date with any degree of precision.

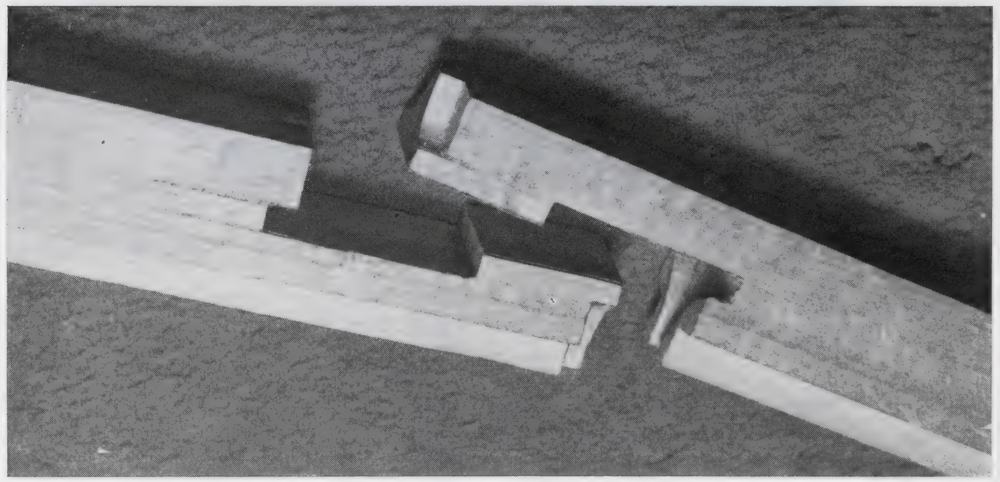
Four radio carbon tests were carried out on three branches of not more than one years growth, also on fragments of keel and planking (used as a single sample), at the Nuclear Physics Division, Atomic Energy Research Station, Harwell. A fifth test was carried out at the British Museum's Research Laboratory; this was a cross-check, Harwell having taken one half of a branch and the British Museum the other; the results were the same (1).

The certificates for the Harwell tests, which give the full details of the methods used, are to be found in Appendix I, p. 279. In view of the difficulty a layman may have in

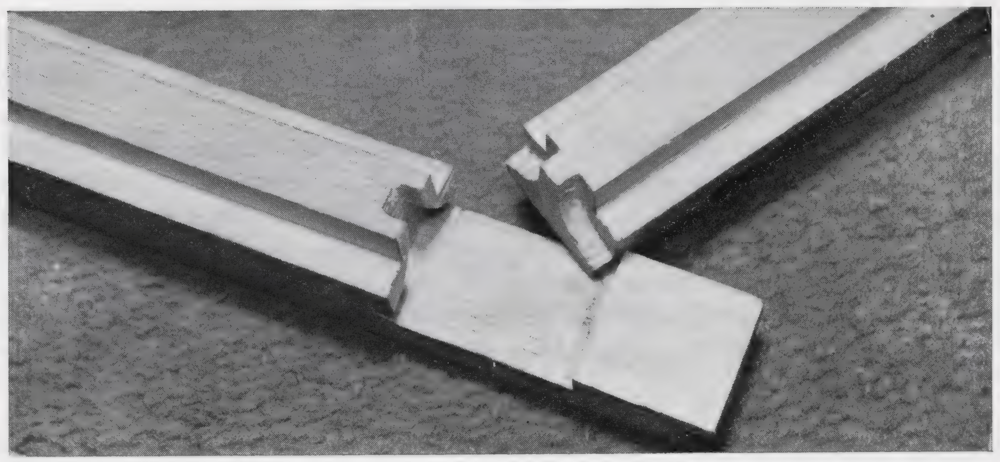
(1) I am deeply grateful to Mr R. L. Otlet and Dr. Richard Burleigh for their personal interest and collaboration, and to the Nuclear Physics Division and the British Museum for their generosity in carrying out these tests.



a



b



c

Fig. 175. – *a–c*) Detail of the elaborate keel scarph (see fig. 8) from a 1 : 5 (model by Austin Farrar).

interpreting these findings, I quote a summary that was personally communicated by Mr R. L. Otlet (Harwell):

" I weighted each result according to its ± error estimate in calculating the overall mean and standard deviation. This gave the corrected calendar age of 235 ± 65 B.C.

Please note my comments in the notes of explanation which go with the certificate results regarding the meaning of the ± error term. You will see that statistically there is still a 1 in 3 chance that the true mean lies beyond the ± 1σ limit i.e. later than 170 B.C. or earlier than 300 B. C. "

The paleography of the alphabetic signs indicates a date between 300 and 260 B. C.

Remembering the amount of wrecks in this zone and the fact the three we examined (i.e. including the "Anchor and Spear-head" Site, p. 16) were warships, an historical background is suggested. Nevertheless in antiquity as now, fleets were composed of a great variety of ships and historians who dismiss a battle in a few lines are not going to dewell on the story of one small liburnian. We know that on March 21st, 241 B. C., 50 Punic ships sank after being intercepted by the Roman fleet while they were attempting to cross from the Island of Favignana/Aegusa to Marsala/Lilybaeum. Favignana the nearest of the Egadi Islands is opposite the wreck-sites at Isola Lunga and only 15 minutes distant by modern motor launch.

This was the decisive battle of the First Punic War. The Punic fleet was hastily summoned back to Sicily to oppose Gaius Lutatius who had unexpectedly returned from Rome with a new fleet manned by picked men. On arrival during the late summer, he had seized the harbour at Trapani/Drepana and the roadsteads at Marsala/Lilybaeum and blockaded the Punic garrisons. The following spring when the Punic fleet arrived it was at a disadvantage, being laden down with relief supplies (presumably in addition to some fighting ballast); the intention had been to unload the supplies at the Islands and take on reinforcements before giving battle, but Lutatius did not allow this to happen, he put to sea immediately. The wind blew against him, but this handicap was outweighed by the manoeuvreability of his ships compared with the overloaded and badly manned ships from Carthage. The wind being against the Romans, coming from Drepana, it must have been blowing onshore, so that the 50 Punic ships that were sunk as a result of the ensuing engagement would have been carried towards land (unless we assume that they all nose-dived to the bottom on impact, which would have been very unlikely).

No details are given of the kinds of ship that were lost that day, nor is it certain that this liburnian perished during this battle rather than at some other time. There must, for instance, have been one or two Punic ships in Drepana harbour and Lilybaeum's roadsteads before Lutatius had seized these places, else the news of his arrival could not have been carried back to Carthage. However this may be, there is no other battle on record that would explain the presence of so many wrecks off this particular shore at Isola Lunga. Certainly the wrecks we examined showed that both the Punic and the Sister Ships had been broken by impact before settling into the sand, but again, only careful excavation of other wrecks in this zone could prove or disprove the general hypothesis.

Finally, the pottery is of little help, because in William Culican's view based on all the sherds we lifted, even those from the surface of the seabed, the consensus dating should be late (rather than mid-) 3rd to late 2nd century B. C. He does, however, add the proviso that " all belong to a period in which neither Italian nor Punic pottery is specifically dated "; once again, we are left with the choice of either accepting the date 241 B. C. or awaiting the evidence of further comparable excavations.

Provenance of the Ship

Extensive identifications have been carried out on the contents of this wreck; they must now be examined for some common factor that might illumine the question: where was the ship built?

One surprising factor presents itself: pottery metal and stone all point to the region of Rome, or the nearby coast. The presence of bracken on board has already made it seem unlikely that the ship was built on the flat, salt-pan covered coast between Marsala and Trapani.

Culican notes: " the connexion of the ship's pottery is overwhelmingly with central Italy . . . not a single example of the smaller vessels is Punic in origin ". This by itself is not very surprising, considering that since the 5th century B. C. pottery had been imported into Carthage itself and that these imports were largely of Greek and Etruscan wares (it is thought that the Greek wares passed through Etruria, but whether they were afterwards shipped in Etruscan or Punic bottoms is more uncertain).

Dr. N. H. Gale commenting on the lead isotopic ratios, finds a resemblance between the composition of a tack from the Sister Ship (both ships contained the same pottery) and galena from Bottino in Tuscany. The other similarity in isotopic composition that he mentions is not so clear cut; it is between lead sheathing from the Punic Ship and coins from a Sardinian mint, but the connexion is not yet confirmed by Sardinian galena (which may only mean that we lack samples representative of the ancient Sardinian mines: alternatively that coins from some other source had been melted down and re-minted in Sardinia).

Georges Mascle's extensive examination of the ballast stones offers three choices: 1) accepting the aggregate of the stones as coming from the region of Rome (his alternative, Naples, need not be considered for historical reasons); 2) deliberately excluding the diagnostic stones and attributing the ubiquitous remainder to, for instance, Western Sicily (already virtually excluded by the bracken); 3) dismissing all the ballast, as insignificant because it might be a mixture discharged from other ships in the yard where the Punic Ship had been built.

In each case, pottery, lead and stone, the question remains open. Nevertheless the recurrence of the curious correlation with Rome or Etruria should not be entirely disregarded, especially as we know that this ship was new when she sank. This not only implies that her contents came from the place where she was built and not some port of call, but it precludes the possibility of this ship having been captured and used by the Romans. Further, having been constructed from standardised parts, these parts could have been shipped to and then assembled quickly at any offshore island or small coastal town in the same way that MTBs were assembled in places all round the British coast during the 1939 war.

In the case of the small pottery, it came certainly and without exception from central Italy and names such as Veii recur throughout Culican's identifications. There are only two possible explanations: either a shipment of these wares had reached the place where the Punic ship was being built, or she had been equipped in the region where these wares were made. Again, archaeological evidence is beginning to suggest that the old Punico-Etruscan connexion might not have been entirely stamped out at this period, despite Roman dominance and the presence of Roman garisons inside Etruria.

Beyond this single, surprising correlation, there are as yet insufficient comparisons on which to base any other hypothesis about provenance. Shipbuilding timber being essentially an imported product, it gives no clue as to where any particular Carthaginian ship

had been built, but on the evidence we have it is reasonable to suggest that the Carthaginians obtained their shipbuilding wood from the same conveniently situated forests, and carried it by sea along the same lanes that were sailed by their Arabic successors at Tunis, when they in turn had used the town as a base for controlling shipping in the central Mediterranean.

If much evidence has to be left for future interpretation, other findings from this excavation already confirm or add weight to existing archaeological thought. For instance: the bones on this wreck together with those excavated on land at Motya, give a clearer idea of Punic husbandry and diet. But one set of results, i.e. those relating to the essentials of a ship excavation, need no qualification.

The Architecture of the Ship

Firstly, thanks to William Johnstone's study of all the marks and signs left by the carpenters, there is no longer any doubt about the ancient technique of shell construction, as applied to this warship.

The rise of the stern was laid and joined to the rest of the keel by an elaborate scarph. The eventual spacing of the cross timbers was then marked out along the port side of the keel, while directions for the joinery of the garboards were set out on either side of a line painted down the centre of the keel. The garboards themselves were shaped with an adze to give the basic curvature of the hull, then starting on the starboard side one of them was joined to the keel; the first 3 strakes followed being built up independently, one after the other. Afterwards, when the shell of planking had been carried up to the height of strake no. 11, the alphabetic identifications of the ribs (already set out on the port face of the keel) were repeated on the inside of strake no. 11 where the carpenters could see them and select the appropriate timber to fit each predetermined position. At first they fitted the floor-timbers, trying each one in its place and scoring lines down its sides onto the planking, before removing it in order to drill the dowel-holes. They then replaced it between the score-marks and secured it with dowels and nails. Once these floors had been fixed, the sides of the hull were carried up to deck-level. At this juncture there is certain proof that at least some of the strakes (notably those at the waterline, that bore spray deflectors on the outside) had been joined together on the flat, before being erected on the now almost vertical side of the ship. Finally the frames, or ribs, were tried in their positions (starting between the tops of the floor timbers, then continuing upwards to deck-level) before being drilled, replaced between score-lines and then secured.

To this remarkably clear structural evidence, Paul Adam's studies have added the three dimensional shape of the vessel, thus explaning the technically enigmatic " swan's neck " silhouette made familiar by the representations of ships on coins and paintings of the classical period. Adam realized that quasi parallel sided planking (unknown in the European tradition, except from the wrecks of classical ships) meant that the extremities of a hull could only end in one of two ways. Such planking would rise gently, giving a spoon-shaped extremity which could conveniently be brought into a sternpost that was slightly curved at least in its upper part. Alternatively if this spoon-shape had to be avoided, as would be the case at the bows (because a spoon-shaped prow would make steering difficult), such planking would have to be brought into a vertical stempost.

All this he worked out on paper (2), but the proof that it had indeed been the technical solution was given by the vertical stempost on the Sister Ship. This timely, complimentary discovery provided the solution to a further long-standing technical question, namely the structure of the " retroussé nosed " type of ram. All that had previously been known about it derived from ambiguous representations and even more ambiguouus texts, which some scholars had interpreted as meaning that such a ram was the prolongation of a keel. The Sister Ship now shows this ram to have been an appendage, designed to break on impact without endangering the hull to which it belonged. After the discovery, this ram-structure appears so obvious that it is already becoming difficult to realize how the alternative hypothesis could ever have been seriously maintained.

Both Johnstone's and Adam's findings also throw light on the speed with which classical ships could be built. The methods that were used leant themselves to streamlining and to massproduction. In addition to pre-planning and the assembly of standardized parts, the use of parallel-sided planks, for instance, obviates one of the most time-consuming operations in the building of a ship. In the forms of European shipbuilding with which we are conversant, strakes are always slightly curved, so that each one has to be tried against the next and its shape modified accordingly before the two can be joined; with two straight edged planks this is unnecessary.

The facinating potentialities of this unfamiliar form of construction warrant fuller discussion. Doubtless the subject will be renewed once specialists have examined, in Marsala, the reconstructed remains of this Punic long-ship.

Honor Frost

(2) P. Adam, *An Attempted Reconstruction of the Marsala Punic Ship*, in *The Mariner's Mirror*, vol. 63, 1, 1977, pp. 35-37, *and an account of the reconstruction: H. Frost*, (*Archaeology 2959*). The Illustrated London News, *May 1980, pp. 62-65*.

APPENDIX I

RADIOCARBON DATING

The Certificate

Samples sent for analysis by: Miss H. Frost, Welbeck Street, London.

Results:

Punic Ship series

1 Harwell Ref.	2 Senders Ref.	3 Type	4 $\delta\,^{13}C$* (± 1%)	5 Age bp (yrs)	6 bp-1950	7 Comment Ref.
HAR-167	Branches	Wood	—21.1	2260±105	310 bc	1
HAR-208	Keel and Planks	Wood	—25.0	2180±100	230 bc	2
HAR-310	Branches	Wood	—28.0	2160± 70	210 bc	3
HAR-499	Branches	Wood	—27.8	2050± 60	100 bc	4

1. Corrected date BC 390 ± 120
2. Corrected date BC 300 ± 120
3. Corrected date BC 270 ± 85
4. Corrected date BC 140 ± 80 (This sample supplied by R. Burleigh, British Museum who also carried out an independent measurement)

This certifies that the samples given above have been analysed for Radiocarbon at this laboratory. The results, expressed as 'Age bp' and 'bp-1950', are given in accordance with the method outlined in the accompanying 'Notes Sheet', NS/1/75, to which due reference should be made. An additional analysis for the stable carbon isotopes ratio is indicated by a result ($\delta^{13}C$) in column 4.

* Expressed as $DELC_{13}$ in 'Notes Sheet' NS/1/75.

Comments: Corrected dates are determined from the tables and method of Damon *et al.*, 1972. Weighted mean on results 1 to 4 is; bp 2130 ± 45 which corrects to a best estimate calendar date of 235 ± 65 B.C.

Notes on the Method of Reporting Radiocarbon Results in the Accompanying Certificate

1. *Age bp* (Column 5): is the Conventional Radiocarbon Age calculated using the following Standards and parameters.

1.1. *Half-life*: The old (W. F. Libby) value 5570 years is used. This is in accordance with the decision of the Fifth Radiocarbon Dating Conference, Cambridge, 1962 and reaffirmed at similar meeting since. It is also a requirement of the publishers of 'Radiocarbon'.

that this half-life value is used in dates reported therein. 'Age bp' results can be converted to the most recent value of half-life, 5730 ± 40 yr [17], by multiplying by 1.03.

1.2. *Modern Standard*: The oxalic acid standard issued by the National Bureau of Standards (NBS), Washington is used. Following the recommended practice, 'Modern' is taken as 0.95 times the activity of the standard after correction for fractionation during its preparation. Reference standards are routinely checked against freshly prepared samples of the NBS oxalio acid.

1.3. *Background Standards*: Samples prepared from Marble, Coke or Fuel Oil were used in the initial setting up procedure to determine the best, mean value background figure. This is routinely checked against additional samples freshly made and using the full sample preparation process.

1.4. *Stable Isotope Correction*: This is expressed as $DELC_{13}$ (Column 4) and represents $\delta^{13}C$, the deviation per mil, of the ratio of the stable isotopes $^{12}C/^{13}C$ of the sample from that of an adopted standard (PDB). The 'Age bp' value quoted (Columns 5) is already corrected for the $\delta^{13}C$ value given in Column 4. If there is no measurement of $\delta^{13}C$ a value is assumed which causes zero correction to be applied in 'Age bp' calculation, ie —25.0 ‰.

1.5. *Bristlecone Pine Correction*: *No correction is applied to the results given in the certificate table.* The laboratory will be pleased to advise on possible appropriate conversions to true Calendar Ages should help be required. Lack of general agreement on which calibration curve to accept induces a reluctance to quote converted dates routinely on this certificate although a corrected value will be given (in the 'Comments' section) if specifically requested.

2. *Accuracy* of the measurement of 'Age bp' is expressed in the associated error term ($\pm$ value) as $\pm 1\sigma$ (standard deviation) inherent to the measurement process. It is not an error which can in any way allow for contamination of the sample or any judgement based on geologic or archaeologic grounds. It includes the laboratory's estimate of their own reproducibility ie 68 % of all identical replicate samples are expected to give results within the limits of $\pm 1\sigma$; 95 % are expected to give results within $\pm 2\sigma$. Inconsistent error terms, eg when similar samples are quoted as having significantly different $\pm$ values, are generally due to the variations in the yield of CO_2 from the samples supplied. Samples giving inordinately high error estimates because the sample size was below that normally required are usually accompanied by a comment identified in Column 7.

3. *bp–1950* (Column 6): In accordance with the requirements of the publishers of 'Radiocarbon' this is reported as dates 'ad' or 'bc' after subtracting 1950 from the quoted 'Age bp' although, as stated in 1.5, no further correction to bring the result nearer to the true calendar date has been applied. To emphasise this point, lower case characters are used in the certificate table when specifying 'ad', 'bc' or 'bp' but it should be noted that this convention [2] is not yet acceptable for Radiocarbon date lists. 'Infinite' dates reported as 'bp' (ie before 1950) only.

REFERENCES

[1] *Nature*, Vol. 195, No. 4845, p. 984, 1962.
[2] *Antiquity*, Vol. 46, p. 265, 1972.

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APPENDIX II

POTTERY FROM THE SURROUNDINGS

In under sea excavation, the amassing of intrusive material is inevitable, because a diver who makes routine checks on the anchors of the boats moored near the site, or who has to swim some distance down current to retrieve a lost float, is bound to notice the antiquities that lie on the surface along his path. I was always reluctant to lift such finds, because they would only cause confusion and extra work at base, especially when digging was in progress on the site itself. Equally they could not be ignored so they had to be marked and inspected.

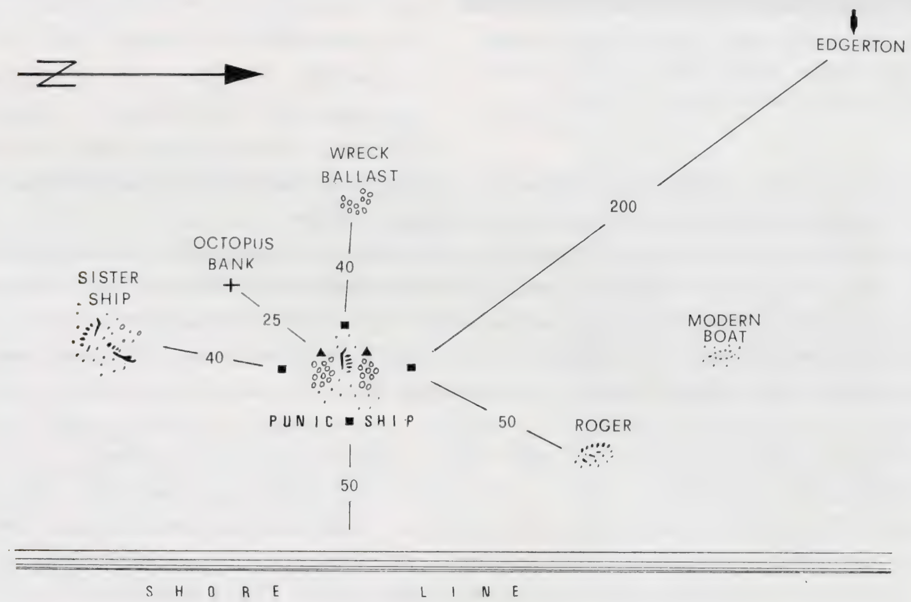


Fig. 176. – The unexcavated sites nearest to the Punic Wreck. Immediately to the west is a site marked only by ballast stones among which we never noticed either sherds or wood. Further north-west the wreck named "Edgerton" (Dr. Edgerton having picked up its buried remains during his brief survey of the zone) was marked on the surface by some mortised timbers as well as Dressel 1ª type amphorae. Landward to the north-east lay the hull named "Roger" whose timbers were revealed from time to time by movements of the sand. Its construction was neither of the Classical period (i.e. the planking was not joined by mortise and tenon) nor was it modern. The "Sister Ship" and "Octopus Bank" are described in the text.

There are arguments in favour of lifting (the most obvious being to prevent objects being taken by souvenir-hunters attracted to the zone by our presence there); further at the beginning and end of a season, when the excavation pumps were not working, the raising of interesting finds from the surroundings provided occupation for all members of the excavation. Finally, during the last season, in 1974, it was our policy not to abandon significant objects.

The seabed in this wreck-filled zone is, of course, littered with sherds. The reasons are many and obvious: when a ship is sinking some of its contents, such as corked amphoras,

will float or roll for long distances until they are stopped by an obstacle such as another wreck. At sea there is also the tendency for things to be washed onto the shore; in addition in the area where we were working, there was lateral drift (the wind-currents being either from north to south or vice versa). The movements of some sherds were also attributable to the sand-dredger working over a kilometre south of our site. When it inadvertently broke into a wreck, the pottery thus loosened would be carried along with the flow of currents or peripatetic sandbanks. In addition pottery was constantly being loosened by dragging anchors belonging to fishing or pleasure craft. The area off Punta Scario where the dredger took sand is particularly rich in wrecks so the dredger was bound to hit them. This was certainly not intentional, because an admixture of sherds made the sand unsaleable for glass-making. Consequently whenever the dredges's drilling head touched a wreck, work had to be stopped and men sent out in a dinghy to examine the obstruction though a glass-bottomed bucket; if it was large, the dredger would have to change position.

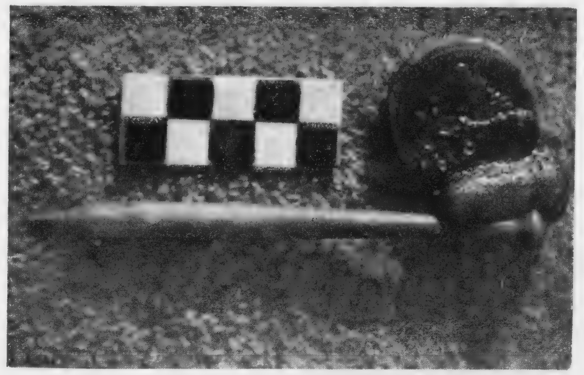


Fig. 177. – *As* and wooden *stylus* (joined together by the concretions around the head of a nail), found in the "Octopus bank" fig. 176.

Near the Punic wreck and to the north of it the sand was both compacted (therefore difficult to dig) and not of saleable quality, consequently the dredger never worked there and we had relatively less information about what lay buried beneath the surface. Nevertheless several wrecks (such as "Edgerton", marked by the Dressel 1B amphoras) were distinguishable on the seabed: indeed three wrecks almost touched our own (see fig. 176). But despite the superficial scattering of artifacts, soundings in depth around the Punic wreck proved it to be isolated by a sterile belt of sand beneath the surface.

A surprising but important cause of dispersal of material from wrecks is the octopus. A provenance frequently cited in our Registers is "the octopus bank"; this term being guaranteed to baffle non-diving archaeologists, it must be explained. Octopuses, like magpies, collect and hoard in their nests any small object that takes their fancy. There used to be three octopus nests on the Punic Ship's ballast piles until the 1973 sand-bank buried them and the animals were forced to find shelter elsewhere in the vicinity.

Perhaps it was one of these refugee octopuses that settled among broken amphoras, on the surface of the sand, some 25 m. from the fixed-point marking the southernmost limit of the Punic wreck. At the beginning of the 1974 season, while we were waiting for the pumps to be made ready, we opened this nest and found in addition to the sherds: a coin joined by concretion to a perfect wooden *stylus* (fig. 177) and underneath it a small plastic bag containing a label bearing a 1972 date in my handwriting. It was one of the bags for smallfinds which we always kept in readiness on the seabed. Apart from this forray by the octopus onto the Punic Wreck, there was no evidence of any connexion between the other "treasures" in his bank, or the amphora sherds he had collected around it and our own excavation. The nail, for instance, that was found in this same "bank", and that has been examined metallurgically by Dr Tylecote (see Appendix III), differs in structure from the nails of both the Punic and the Sister Ships which he also examined in the same way. This, of course, suggests that the nail from the "octopus bank" had been taken

from one of the other nearby wrecks. The same may or may not apply to the black glaze and other sherds found in the "bank"; all are given in the appendix that follows.

Finally, the coin from the "octopus bank" is a copper *As* of the sextantial series which are now dated as being struck from 210–200 B.C. It bears a Janus head on one side and the rostrum of a ship with the word ROMA on the other (1).

It would take years of disciplined archaeological sounding to unravel the exact provenances of the pottery types within this zone. In addition, it must not be forgotten that all the ancient sherds did not necessarily come from wrecks. Like the modern bottles and plastic detritus with which they mingled, many of them may have been thrown overboard from ships that had moored temporaily behind the Punta Scario to shelter from the violence of the Sirocco.

HONOR FROST

Most of the descriptions and identifications given below are the work of W. Culican. Comments by Honor Frost are in italics.

"PURG" AMPHORAS

All were surface finds, with one exception coming from beyond the southern limits of the Punic wreck. Indeed one "Purg" amphora was sighted on the beach (where we left it) as far south as the dredger's moorings. 12/74 and 7/72 lay to seaward of the Sister Ship where similar sherds had also been collected into the "octopus bank" (see fig. 176). Some sherds which Culican identifies as being of the same ware, such as 148/74, 240/74 26/71 and 61/72, had reached the surface of the Punic Ship's southern ballast pile, but the neck 62/74 was in very shallow water near the beach, beyond the landward limit of the Punic wreck.

Three upper parts of amphoras of a light pinkish buff ware, fairly well purified but with a widely distributed levigation of grey and brown gritty material. There is a yellowish buff slip inside and out, the surface smooth and wiped (figs. 179 *a*; 180).

12/74 'Purg' stamp on top of both handles.
62/74 'Purg' stamp on top of surviving handle.
7/72 'Purg' stamp on top of both handles.

Body pieces, some quite large, were quite numerous, and although it was quite clear that amphoras of this type had globular bodies, no base was found.

282/74 (fig. 179 *b*). A large body part with the wall narrowing considerably towards the top. A deep groove on the shoulder appears to have surrounded the entire vessel. Smaller grooves below end abruptly.

A number of pieces were found south of the wreck: 16/74; 17/24; 18/74; 18A/74; 20/24; 21/74; 23/74; 25/74; 148/74; 240/74.

The following were found in the octopus bank: 62/73; 36/74; 480-483/74.

Miss Joyce Reynolds of Newnham College, Cambridge, has suggested the reading of *P(ublius) Urg(*   *)* – for the nomen *Urgulanius*, *Urgulanus* or *Urgius*, all possible nomina connected with Etruria and with Campania and southern Italy through Etruscan connections. She suggests a date in the 1st century B.C. for the P form. Since there is no point between

(1) I am indebted to Professor Michael Dolley, and to Mrs Archibald of the Department of Coins and Medals, the British Museum, for their help with this identification.

P and URG, it was at first suggested that some *praenomen* coined from the name of Pyrgi on the southern coast of Etruria might be possible, but a third and more likely suggestion is that it is an early version of the name *Porcius* (used equivalently to the 'SEST' in *Sestius* amphoras). R. T. Ridley of the University of Melbourne has kindly made this suggestion and points out that the Latins after borrowing both *g* and *k* consonants from Greek proceeded to disregard the *k* and use gamma for both *g* and hard *c*. Later, as it became necessary to distinguish the two sounds they made gamma, third place in the alphabet stand for *c* (always hard) and had to invent a new gamma (Latin *g*) in seventh place. Thus *Gaius* is still abbreviated C in classical Latin. The new distinction is dated about the end of the 4th century B. C., hence *Porgius* might still have been current in the 3rd and 2nd centuries. As for the *u* and *o* interchange this may be purely epigraphic given the number of variants in the written form of archaic *o* in some of which the shape was penannular. Finally the rotundity of the P form of *Purg* does not militate against a second century date as is witnessed by its even greater rotundity in the PAP Stamps in which the A is very archaic. The *Porcii* came from Tusculum, and are first mentioned in the 3rd century; the Etruscan form *purce* is attested (PAULY WISSOWA, *Realencyclopädie s.v.*). All available evidence points therefore to romanized Etruria as the source of these amphoras.

Fig. 178.

I am indebted to Gerhard Kapitän for both pointing out that necks of similar profile to the "Purg" type can sometimes have tubular "Punic" type bodies, and for photographs of an amphora in the Museo Nazionale di Siracusa (fig. 178). In a letter to me of 18/4/1977, Gerhard Kapitän made the following remarks about our "Purg" amphoras:

«Your type corresponds to Forma 59 of Beltran Lloris, which he illustrates with two finds, one from Tarragona (fig. 231,1), the other Barcelona (according to Pascual) (fig. 232,2). Both have cylindrical bodies of which the lower portions and the foot are missing (MIGUEL BELTRAN LORIS, Las anforas romanas en España, *Zaragoza 1970, pp. 564–566*). *Beltran dates this type 5th cent. A.D. (the find from Barcelona comes from a cemetery at la Plaza del Rey and the cemetery dates later than 4th and earlier than 6th cent. A.D.). The following parallels may also be noted:*

1) *A single neck which was found during the NACSAC expedition 1968 at Cape Graziano, Filicudi, out of context, on the shallow seabed north-west of the rock of the "secca".*

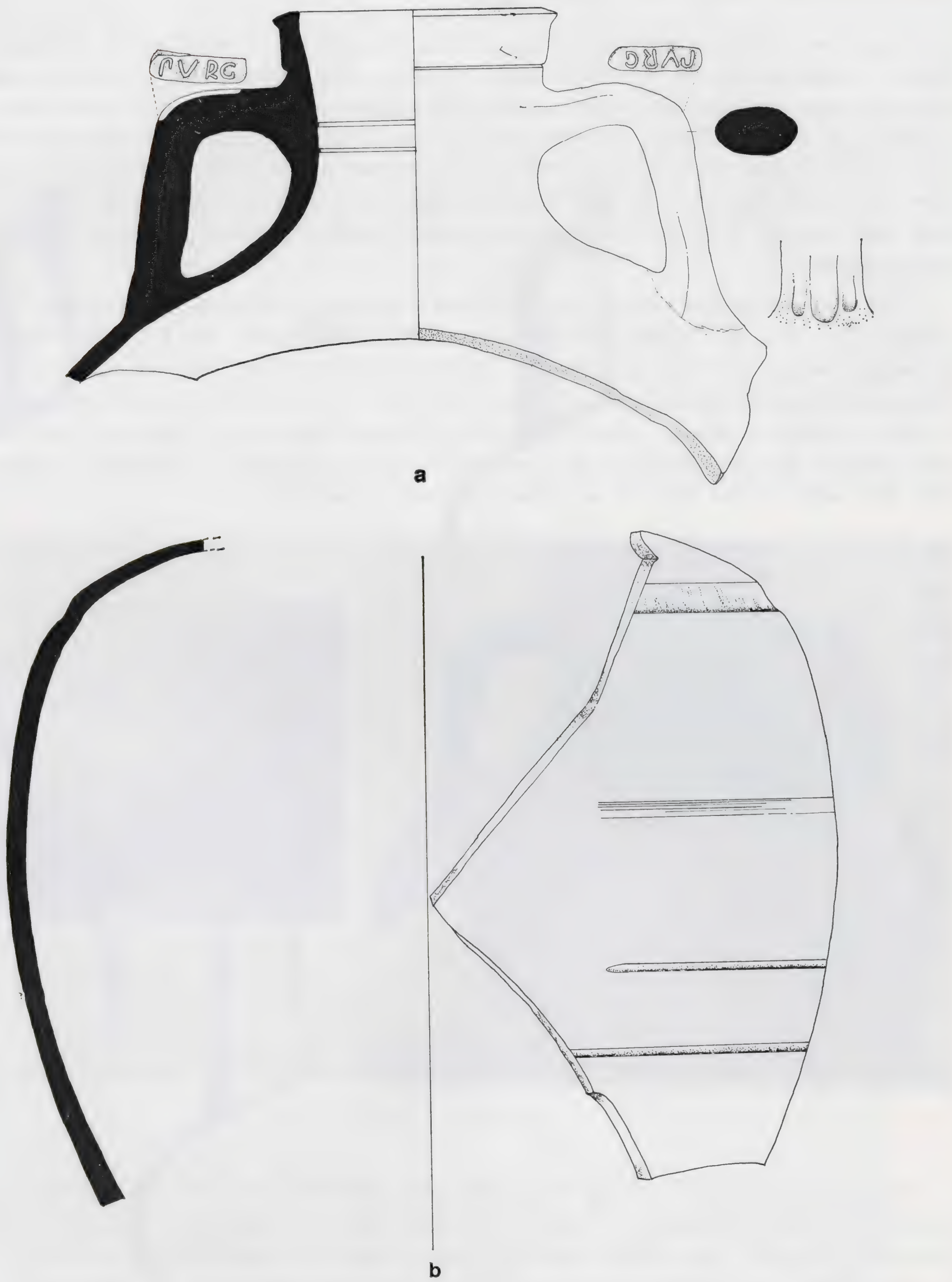


Fig. 179. – *a*) SI/12/74; *b*) SI/282/74 (1 : 3).

The shape is very similar. This neck is now in the Museo Archeologico Eoliano at Lipari with Inv. Nr. 9237. I shall publish this find with a drawing in scale in report which I presented at the 5th Congress at Lipari 1976.

2) *Two complete amphoras from a wreck site called Filicudi Porto A, likewise in the Museo Archeologico Eoliano, Lipari, with Inv. Nos. 10603 and 10604. These two amphoras were confiscated in 1970 from private divers. The site was discovered by the Centro Sperimentale (Albenga) in 1975 or 1976 off the north side of Cape Graziano. Both the amphoras have cylindrical bodies. (I have not yet photographed them, but they are on show in the marine archaeology room of the museum). In one detail they are different to your type and to the NACSAC find from 1968: the lips of both these amphoras incline inwards while on your neck the inclination goes outwards.*

The type in question seems to be a late form of the amphoras of the so called type "africana grande" (F. ZEVI, A. Tchernia, *in* Antiquités Africaines *3, 1969, 173 ff.), which have similar cylindrical bodies. I think that Beltran's dating should be right. The type is certainly a late Roman amphora and the cylindrical shape of the body of all these amphoras may be reminiscent of certain Punic amphoras, which had such cylindrical bodies too. However I feel it may be misleading to describe the bodies as "tubular Punic Type bodies". However it seems almost sure that necks of this type do not belong to globular bodies*».

Fig. 180. - SI/12/74.

Spherical amphoras of *Purg* shape and with collared rims have not hitherto appeared in early contexts, although J.-P. Joncheray illustrates an amphora, presumably from Agde, with a rather similar neck profile and body shape (though the handles differ) which he regards as 'late Greek' and places before 150 B.C. (*Essai de classification des amphores*, n. d., pl. II, 2). It rather resembles Samian shapes (V. R. GRACE, *Samian Amphoras*, in *Hesperia* 40, 1971, pp. 51-95) and this might be yet another source for the inspiration of the shape. It may also be suggested that they stem from a non-Greek amphora tradition and are a late development from the Etruscan amphora (details of which have been collected by F. and M. PY, *Les amphores étrusques de Vannage et de Villevieille (Gard)*, in *MEFR* 86, 1974, p. 142 ff.).

VARIOUS AMPHORAS

Again from the surface of the seabed, the two Greco-Italic amphoras 9/74 and 150/74 were found some 50 m. beyond the seaward limits of the Punic wreck, beside yet another pile of ballast stones from another wreck (see fig. 181). There is, however, no more reason for supposing that these two amphoras were associated with this new ballast pile (which was never sounded) than with the more distant piles belonging to the Punic Ship. A few small sherds

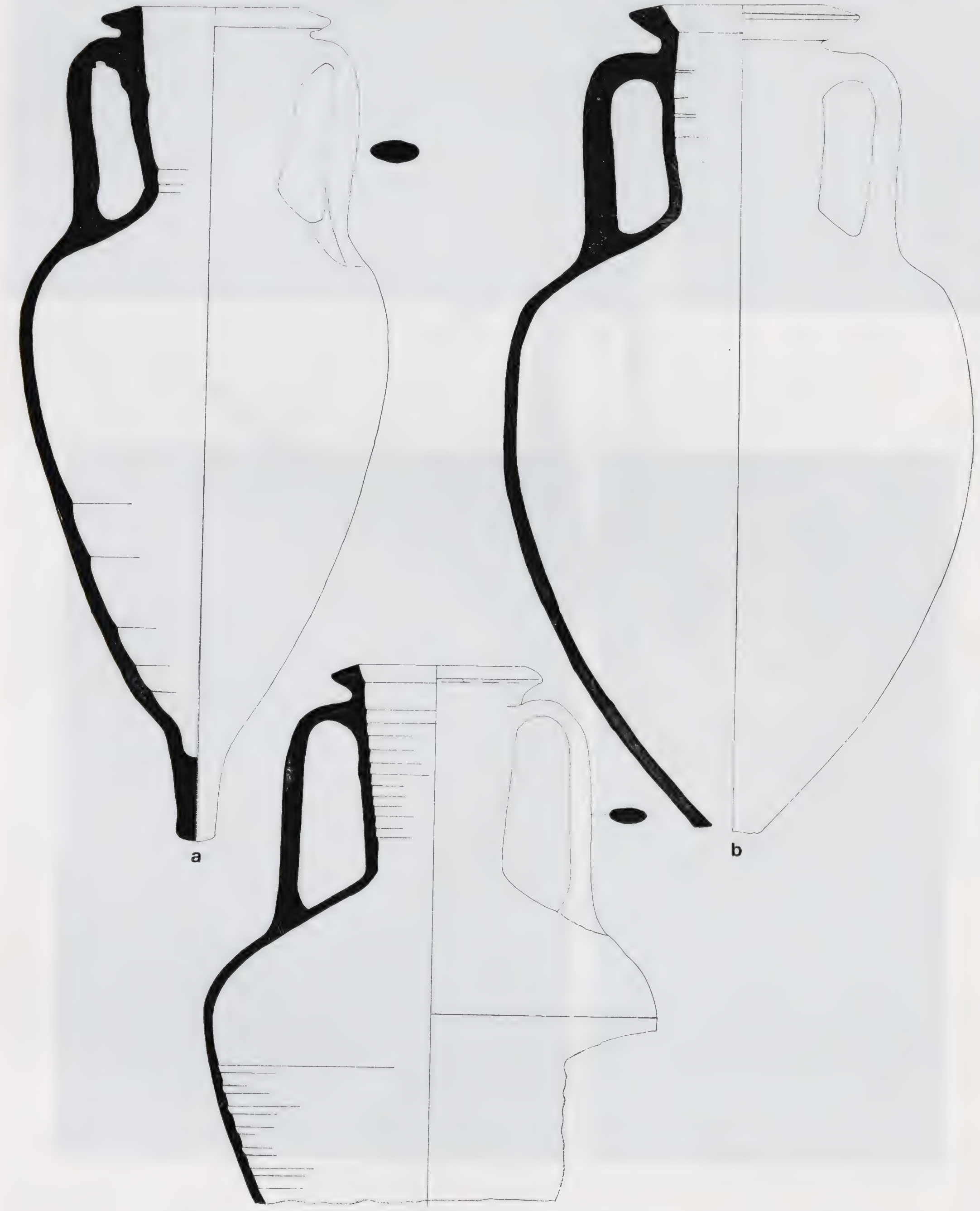


Fig. 181. - *a*) SI/9/74; *b*) SI/150/74; *c*) SI/75/74 (1 : 5).

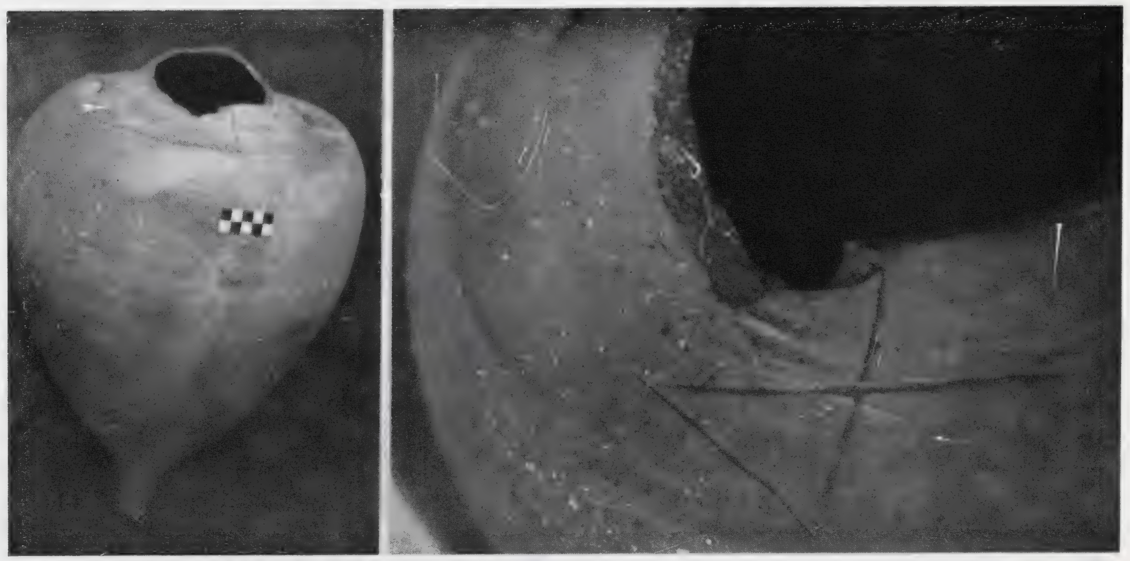
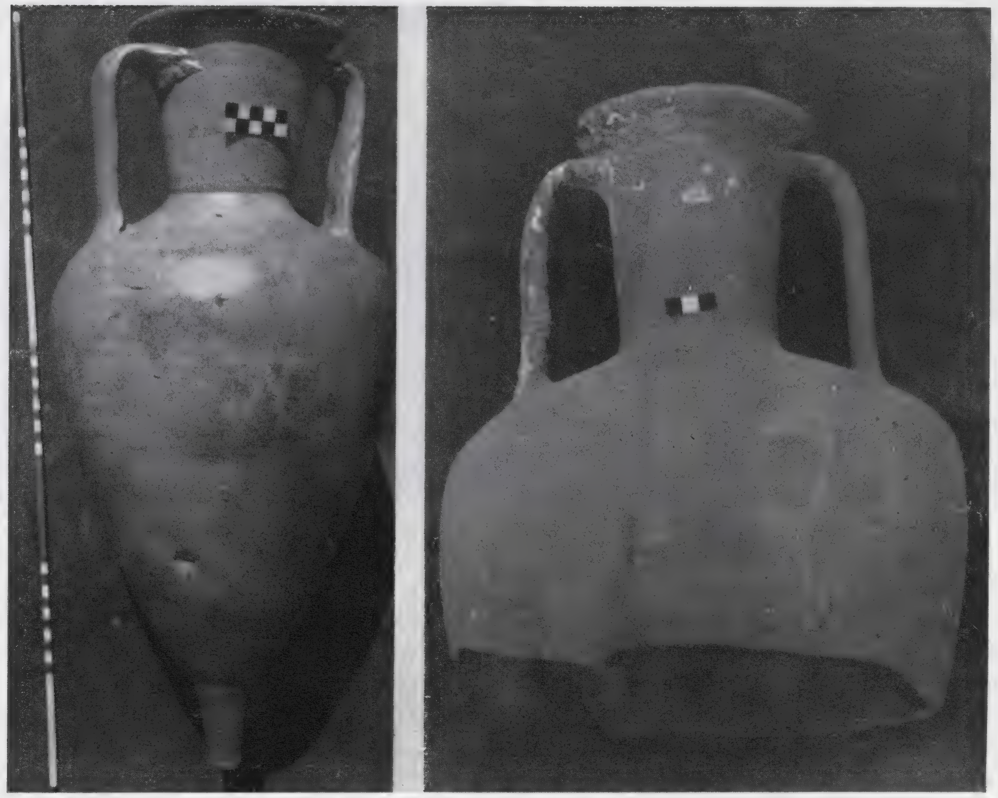


Fig. 182. - SI/47/74.



a *b*

Fig. 183. - *a*) SI/9/74; *b*) SI/75/74.

which Culican associates with this type of ware, had been taken by the octopus to his " bank"; others were cleared from the surface of the Punic Ship's ballast.

The Italian variant 75/74 was also found to the south, near the "octopus bank" and to seaward of the Sister Ship. Two sherds of similar fabric were cleared from the surface of the Punic Ship's ballast.

9/74 (fig. 181 *a*, 183 *a*). This small amphora is Hellenistic in shape, but the fabric and grits are closer to amphoras of Italian type. The clay is grey reddening on the inside and covered with a thick buff-cream slipe inside and out. There are multiple micaceous hard black grits throughout the fabric with some very scattered softer white grits. The surface appears to have been pebble-dashed with larger glittering black grits..

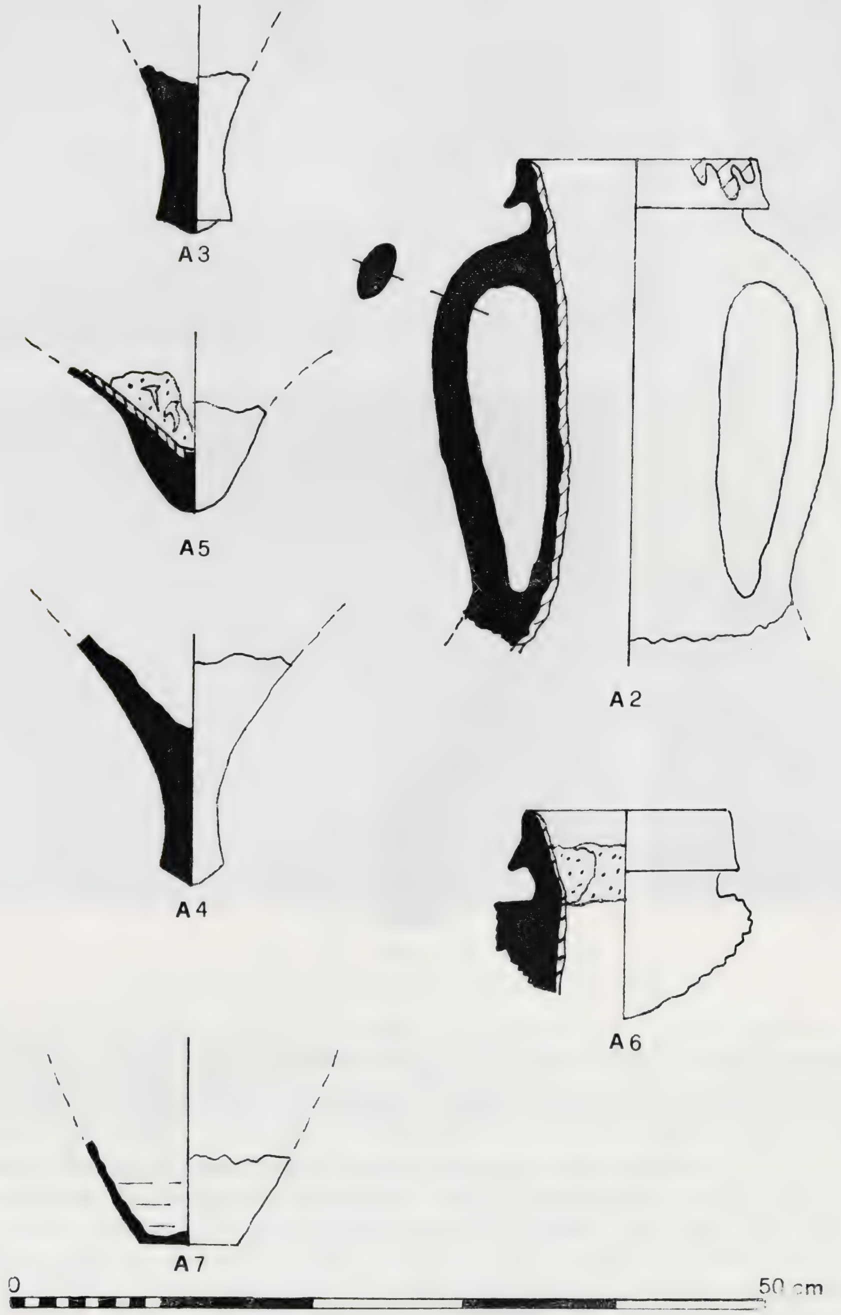


Fig. 184. - Pottery from the Punta Scario Wreck (1 : 5).

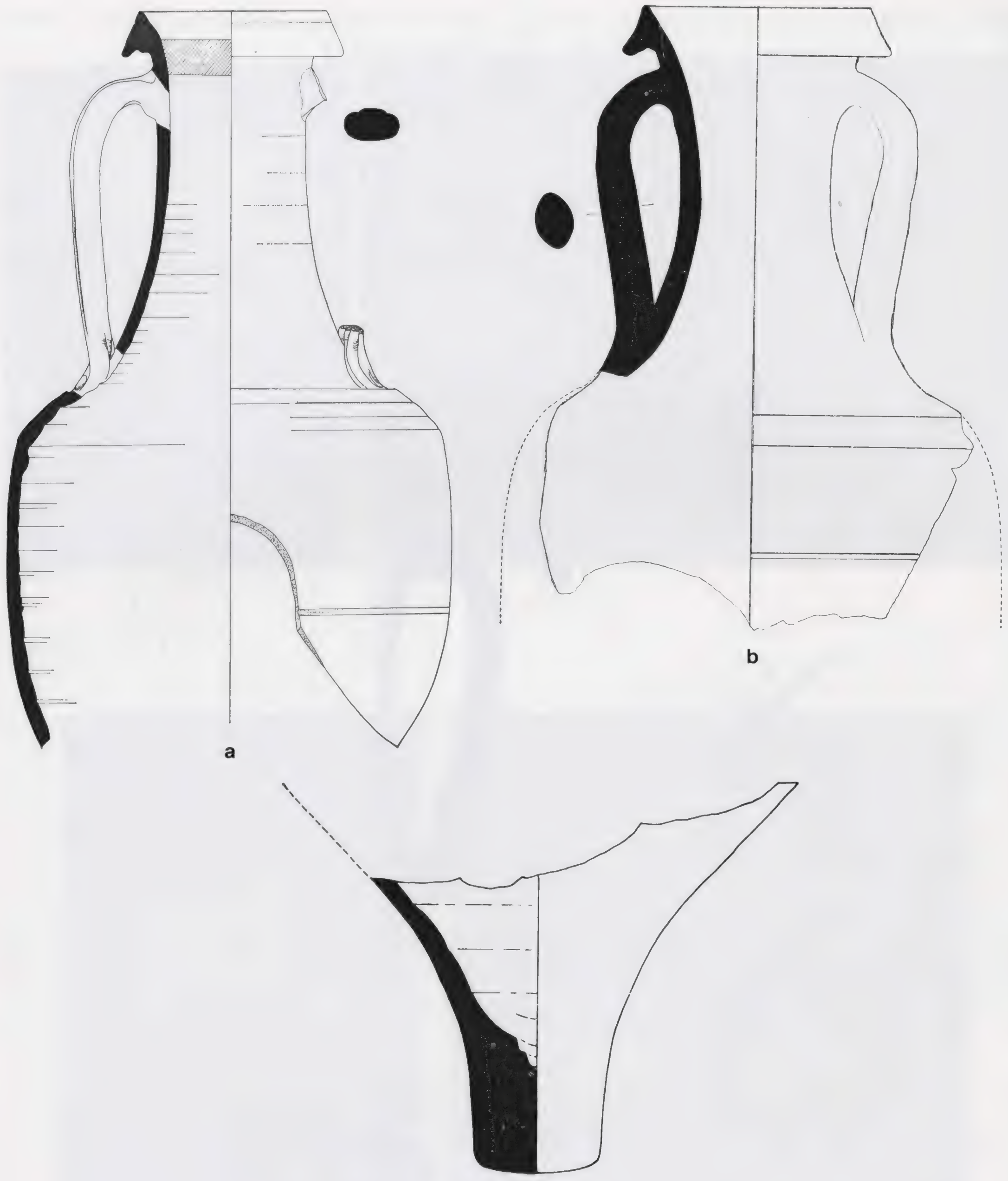


Fig. 185. - *a*) SI/5/74; *b*) SI/4/72; *c*) SI/37/73 (1 : 5).

The shape resembles a short amphora from a 3rd century B.C. Lilybaeum tomb (A. M. Bisi, *Su alcune tombe puniche scoperte a Marsala*, in *BArte* 1968, 2-3, p. 125, fig. 67). Small amphoras from Pennes (associated with Rhodian) are not unike (F. Benoit, *L'Épave du Grand Congloué à Marseille*, in *Gallia* Supp. 14, 1961, p. 34 pl. II, 5).

SI/150/74, 75/74 (fig. 181 *b*, *c*; 183 *b*). These two amphoras should most probably be regarded as intermediary between Greco-Italic and Dressel IA types. These necks are relatively short and they narrow towards the neck base. Rims are triangular in section, obliquely cut, and slightly concave inside. The handles are thin and more delicate than in other types and attach to the middle of the shoulder. The ware is a uniform bricky red, thin and hard-fired with much the same gritty mixtures as Dressel IA, but not in the same quantity. Rosin lined. The juncture of neck and body can be seen only inside the body.

Associated neck sherds:

156/74
172/74

The shape appears identical with a Tripolitanian amphora from the 2nd century B.C. (A. M. Bisi, *A proposito di alcune anfore puniche di Tripolitania*, in *Studi Magrebini* IV, 1971, pl. 1, 3).

Fig. 186. - The "Tile Wreck".

The first four amphoras represented below were found a few metres apart on the surface of the sand, south of the Punic Ship and near the Sister Ship. The peg base of a fifth, (fig. 185 c*) 37/73, was from the beach, about one kilometre to the south, opposite the "Tile Wreck". 47/74, (fig. 182) is assigned by Culican to the Greco-Italic Type 2 (p. 144). It has a basically triangular sign incised (after firing) onto its shoulder.*

The remainder he assigns to "Italian" Type 3: 5/74 (figs. 185 a*, 187* a*) and 10/74 (fig. 187* b*) are two amphoras which still had their corks in place; both have dimples at the base of their handles.*

Another amphora of similar type was found 50 m. to the N of the Punic Ship (fig. 185 b*).*

"Wreck A", Punta Scario

It may be relevant to add that when I first visited Marsala in 1969, I made a rough note (fig. 184) of some bases "A" 3, 5 and 4, a pot base "A" 7, and two necks similar to the above: "A" 2 and 6. These sherds had been in a hole made by the sand dredger; they had been deeply buried on what was evidently another wreck-site at he landward end of the Punta Scario, over one kilometre to the south of the Punic Ship.

The "Tile Wreck".

Another example of the same type of amphora, (fig. 186 a–b) *lay on the surface of the "Tile Wreck". This wreck consists of a large cargo of Roman tiles, (fig. 186* c–d). *It is the only certain cargo carrying ship in the area although excavation might reveal others* (G. KAPITÄN, Relitti antichi davanti all'Isola Lunga, *in* Sicilia Archeologica 9, *1970, pp. 34–36*).

Fig. 187. – 5/74 and 10/74.

209/74 is (fig. 189) part of an unusual amphora found on top of the north side of the Port ballast. It is remarkable for its narrow width, steeply oblique shoulder, and for the excellent fabric which consists of a well-mixed grey-buff paste with a widely even spread of large white crystalline grits. On the outside is a very thick beige slip fired with a pink blush. Rosin lined. There is an identical vessel in the Lilybaeum archaeological store, without rim or base, and what is probably another, also rimless, is pictured by J. Whitaker (*Motya, a Phoenician Colony in Sicily*, 1921, fig. 78) second from left. The severely sloping shoulder to which the handles join seems close to Dressel IC shapes from Ventimiglia VI A, (N. LAMBOGLIA, *La nave romana di Albenga*, in *RStLig* XVIII, 1952, pp. 222-225). For chronology cf. BELTRAN LLORIS, *op. cit.*, p. 309 f.

39/72, (fig. 188 a) *is a neck that was lifted in 1972 from the top of the port ballast pile where it had not been in 1971; its association with the Punic wreck is therefore very doubtful.*

55/73, (fig. 188 e) *and 192/73 (fig. 188* b) *were in the sand-bank that moved onto our site in 1973 and were found while dredging through it in search of the buried ballast piles. Both these necks came from above the seaward limits of the respective piles.*

SF/3/70, (fig. 188 c); *it was not one of our own finds, having been presented to the expedition by the crew of the sand dredger (while they were working to the south off Punta Scario).*

33/73, (fig. 188 d) *was found on the beach, level with the "Tile wreck".*

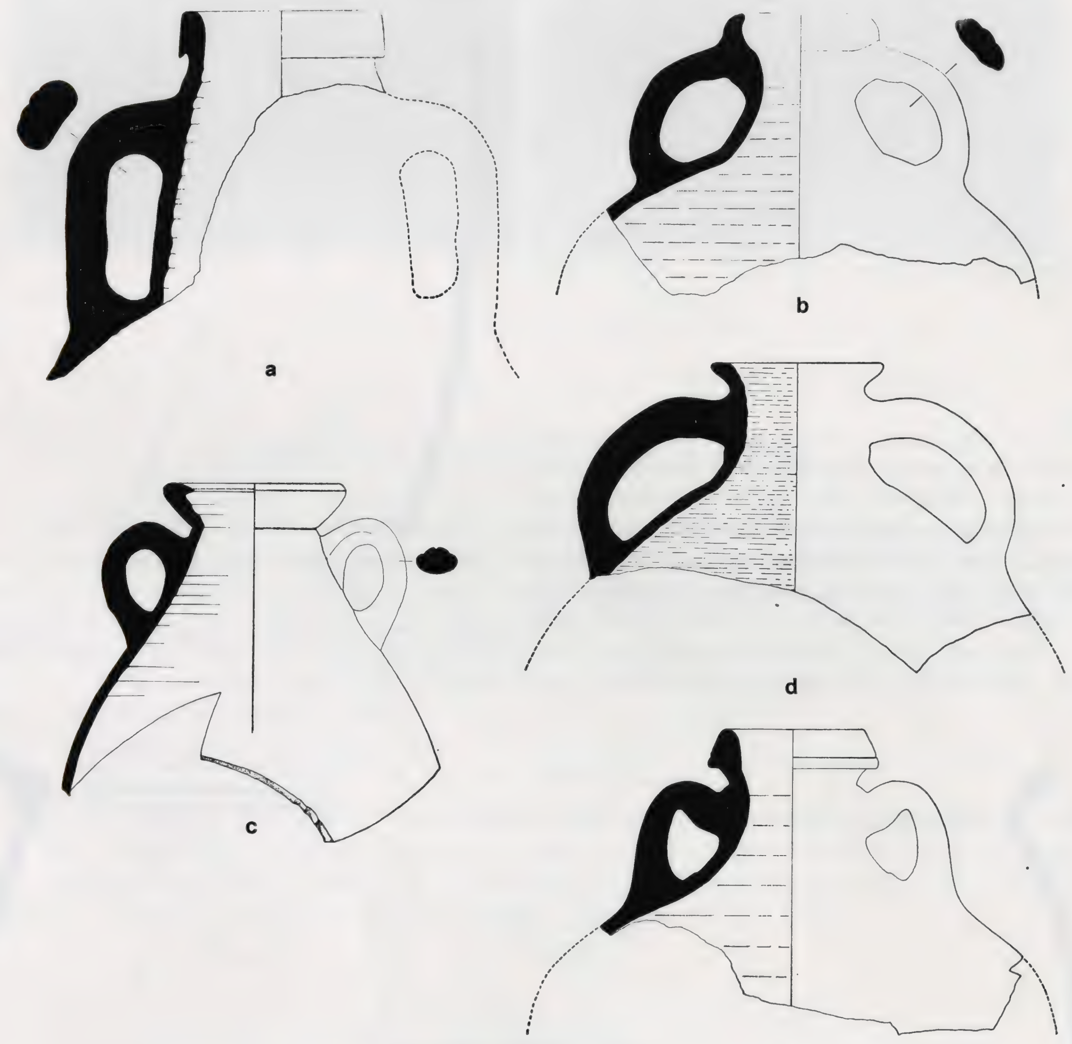


Fig. 188. – *a*) SI/39/72; *b*) SI/192/73; *c*) SI/3/70; *d*) SI/33/73; *e*) SI/55/73 (1 : 5).

39/72 (*IJNA* 3, no. 22) (fig. 188 d). Neck, rim and one handle of a thin-walled, hard-fired amphora. The ware is now a uniform dark grey with multiple beach inclusions and a few white pebbly inclusions. The neck is conical and the vertical rim has a sharp lower lip setting it from the body. There is an orange slip fired to grey in parts. The handle is thicker on the top than on the bottom and has a narrow fluting down its spine. The wall at the shoulder is very thick compared with the neck. There are regular and close-set corrugations on the inside. Not rosin lined. It may be compared with Dressel shape 26 which has been variously dated between the early 1st century A. D. and the 4th to 5th centuries A. D. (F. ZEVI, *Appunti sulle anfore Dressel I: La tavola tipologica del Dressel*, in *AC* XVIII, 1966, pp. 208–47, pl. LXXX no. 1; M. ALMAGRO, *Las necrópolis de Ampurias II*, 1953, p. 314). There is, however, some possibility that

this is a much earlier amphora, especially since its fabric is not unlike the 'Purg' group. Cnidian amphoras (V. GRACE, *op. cit.*, fig. 64) would provide a suitable prototype.

55/73 (fig. 188 *e*). Grey fabric. Cp. BELTRAN LLORIS, *op. cit.*, fig. 195, which is a type current in the 2nd and 3rd centuries A. D.

3/70 (fig. 188 *c*). Cp. BELTRAN LLORIS, *op. cit.*, p. 558, fig. 228, 3, of the 4th century A. D.

33/73 (fig. 188 *d*). Outer surface dark grey with many white and glassy grits; inner surface light grey with fewer grits. Core very dark grey. 3 incised lines encircling the shoulder at the insertion of the handles and 5 more just below the shoulder.

192/73 (fig. 188 *b*). Grey ware. In general the type is that of 55/73. For the re-entrant rim, cf. BELTRAN LLORIS, *op. cit.*, fig. 187, 2.

Fig. 189. – SI/209/74 (1 : 5).

COOKING POT WARE

1/74 (fig. 190 *a*). *Cooking pot found by the beach near the Punic wreck. Dark grey ware stained brown on the outside: micaceous inclusions (a water-worn sherd).*

29/74 (figs. 190 *b*; 191 *a*). *Cooking pot from the "octopus bank". Rim with carefully featured profile, in hard fired bright tan ware baked to a brownish grey on the outside, well mixed with very small yellowish grits.*

28/74 (fig. 190 *c*). *Found 25 m south of wreck area. A lid of tan ware, evenly fired with scattered large black and small white grits; mechanically smoothed.*

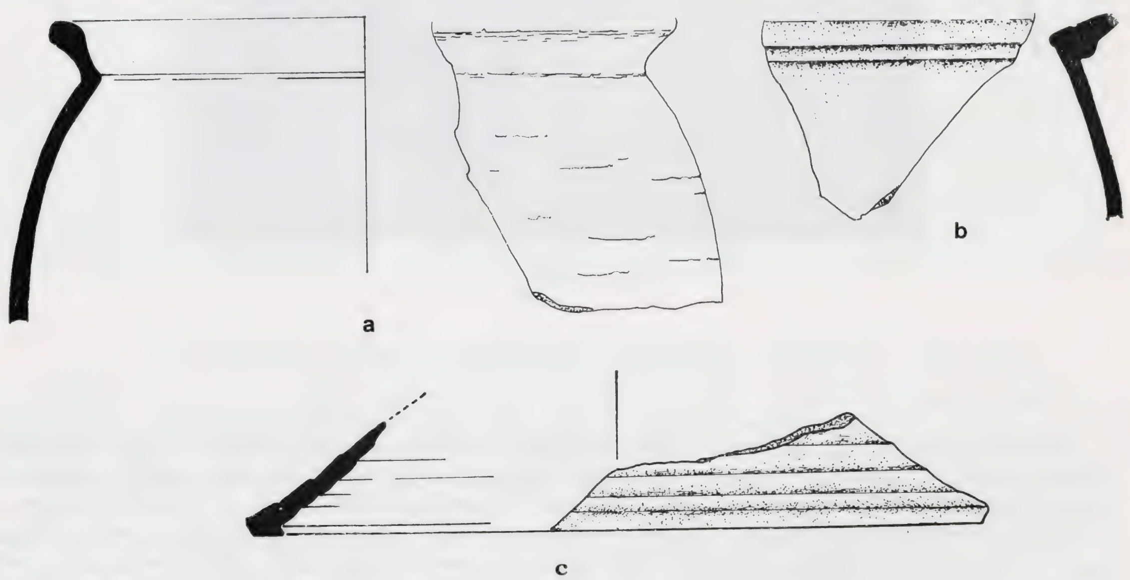


Fig. 190. – *a*) SI/1/74; *b*) SI/29/74; *c*) SI/28/74 (1 : 2).

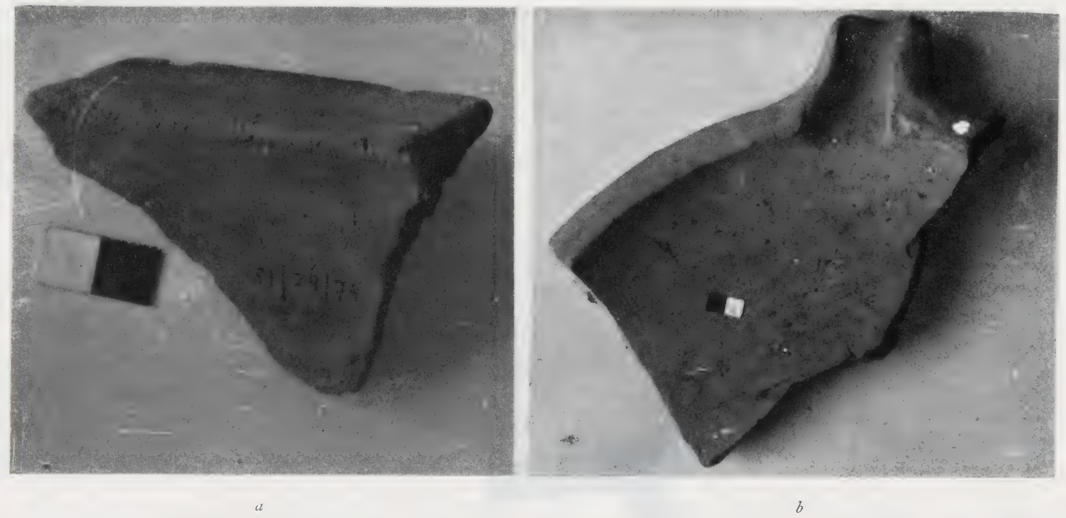


Fig. 191. – *a*) SI/29/74; *b*) mortar 58/74.

HORIZONTALLY RIBBED COOKING POT WARE

Parts of round based cooking pots in a completely different tradition from those in the wreck were found to the north, between the furthest mooring-block and the beach. The ware has closely set ribs as in Byzantine wares and is now dark grey with black and white grits and stratified brown and yellowish layers within.

2/74 *is part of a vessel wall and rounded base.*
69/73 *is part of a sloping wall.*
44/74 *is a sherd from a rounded base.*

Ribbed cooking pots seem to have come into use in the course of the first century A. D. and are plentiful in South Italy and Sicily (e. g. L. BERNABÒ-BREA and M. CAVALIER, *Meligunis-Lipára* II, 1965, pl. CCXXXV, 3). There is plenty of it from Roman Motya (A. CIASCA et al., in *Mozia* II, Roma 1966, pls. IV, 2; XIX).

BLACK GLAZE WARE

Nos 17 and 19/73 were found near the beach, but awash, between the Punic and Sister Ships. 11 and 32/74 came from the "octopus bank" and 107/74 lay on the seabed at least 500 m to the south of the Punic Ship.

17/73 (fig. 192 *c*). Small dish with incurved lip. Cushion foot with faceted ring base and small central boss. Dull glaze discoloured to a parchment hue in places. Brownish red clay, Lamboglia form 25.

19/73 (fig. 192 *e*). Well-turned base in greyish pink fabric with bright, but not lustrous glaze of patchy dark grown tending to black with a patch of dark red on the inside centre.

11/74 (fig. 192 *d*). Part of a plate with flat overturned rim. Red-buff well purified fabric with matt black glaze. Lamboglia fig. 36 *f*. Campanian A.

32/74 (fig. 192 *a*). Is a deep basin with angular incurving lip. Uniform grey ware, well refined with only slight traces of black glaze remaining. Lamboglia form 26.

107/74 (fig. 192 *b*). Upper portion of a flat handled *skyphos*, light reddish-buff ware with shiny black glaze. A comparison comes from Lilybaeum (C. A. DI STEFANO, *Richerche sulle fortificazioni di Lilibeo*, in *Kokalos* XVII, 1971, p. 74 fig. 1).

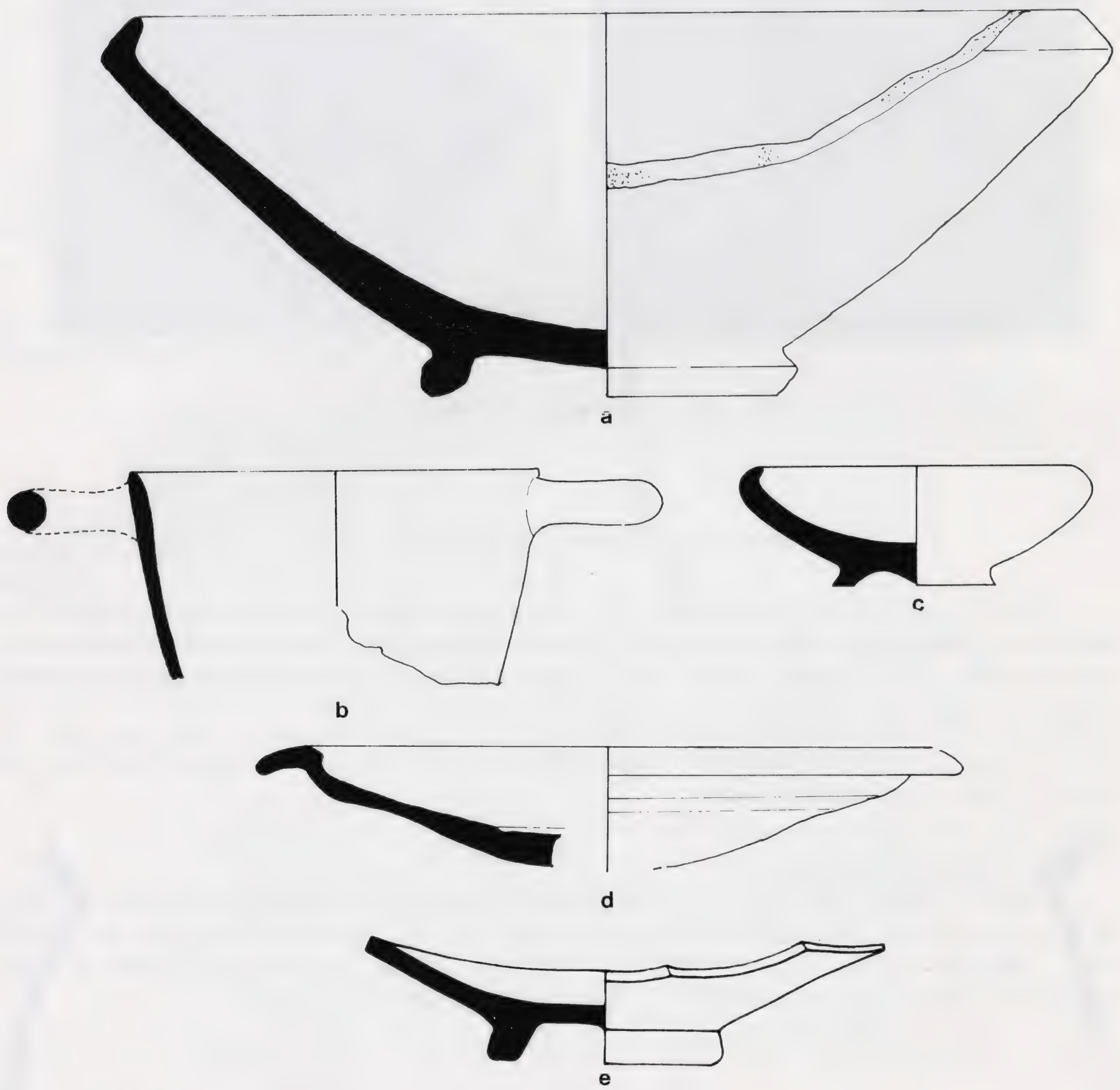


Fig. 192. – *a*) SI/32/74; *b*) SI/107/74; *c*) SI/17/73; *d*) SI/11/74; *e*) SI/19/73 (1 : 2).

MORTAR

58/74 (fig. 191 *b*). *Surface find at 30 m. beyond the southern limit of the Punic Wreck.*
Heavy greyish buff ware with fine levigation and widely scattered very large pebbly grits. Smooth yellowish cream coat on entire surface with pinkish coloration inside.

WILLIAM CULICAN

APPENDIX III

A FURTHER METALLURGICAL EXAMINATION

TWO NAILS FROM THE MARSALA WRECKS.

A. '*Octopus Bank*' (Submitted 1976).

1. *Nail Inserted into dowel.* The main part of this nail has survived. It consists of an homogenised copper-base solid solution with an equiaxed grain structure. It is heavily twinned and contains some sulphide/slag stringers and very little lead, if any. The hardness of the metal is 76 HVI which is representative of a 7 % Sn bronze. No delta phase is present.

Judging from the shape of the corrosion product, the nail had a flat head and probably held some sheet (? lead) on to the dowel and the piece of wood in which it is inserted. The hardness of the dark coloured corrosion product, possibly oxy-sulphide, is 155 HV.

2. *Long Nail.* This nail is entirely mineralised and the blue colour of the product is quite different from that of that of the first, shorter, nail. It contains particles of sand (hardness 1500 HV 0,1 kg) embedded in the blue matrix which has a hardness of 96 HVI. The ' nail ' is in fact hollow which suggests that its corrosion took place by a process of outward diffusion of metal ions until all the metal had been consumed. The sand grains would have been deposited on the nail in the early stages. It is therefore almost certain that this nail fell out of the structure at an early stage and was converted to sulphide under anaerobic conditions.

B. *Short nail*; *Punic Ship* (Submitted 1976).

In many respects this is like the earlier nails examined and reported on in 1976. In the unetched state it contains a grain boundary phase which could be lead. If so, this has not been so well drawn out as in the earlier ones. In the etched state, the head has been clearly cold formed as it shows considerable slip banding. The hardness is 108 HVI due to its severe degree of work hardening. The shank shows the usual twinned and equiaxed structure of a homogenised alpha solid solution and has a hardness of 83 HVI which is in keeping with a 7–10 % tin bronze. The microhardness of the grain boundary phase is 7.5 (26 g load) which confirms the possibility of lead.

30 March, 1977.

R. F. TYLECOTE

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